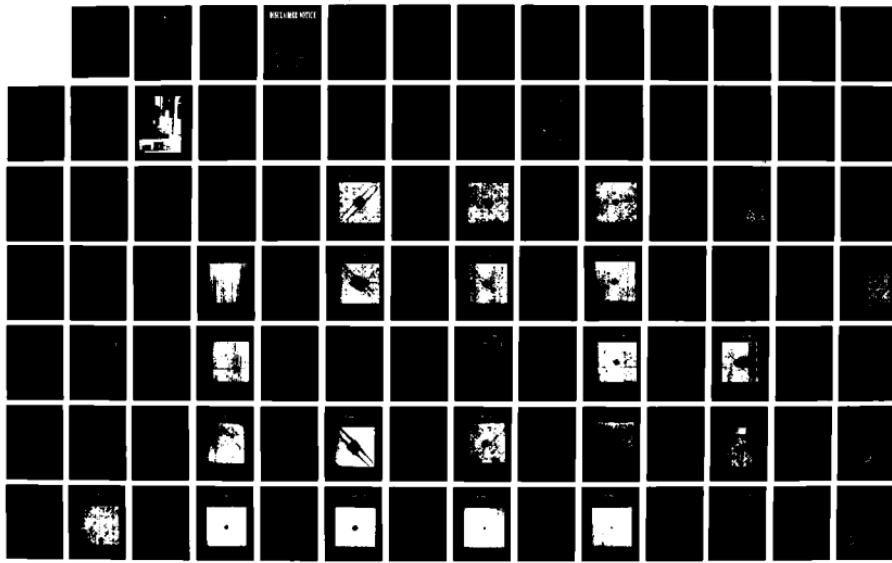
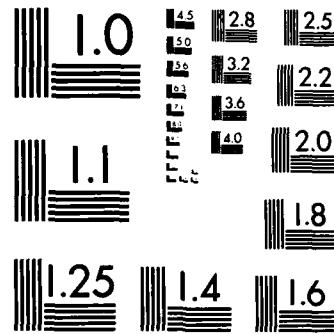


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IMPACT CHARACTERIZATION OF NEW COMPOSITE MATERIALS

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Aircraft and Crew Systems Technology Directorate
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Warminster, PA 18974

FEBRUARY 1985

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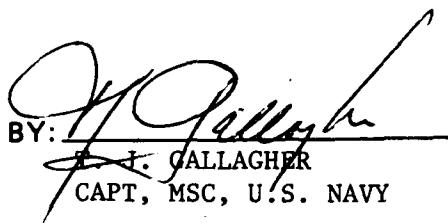
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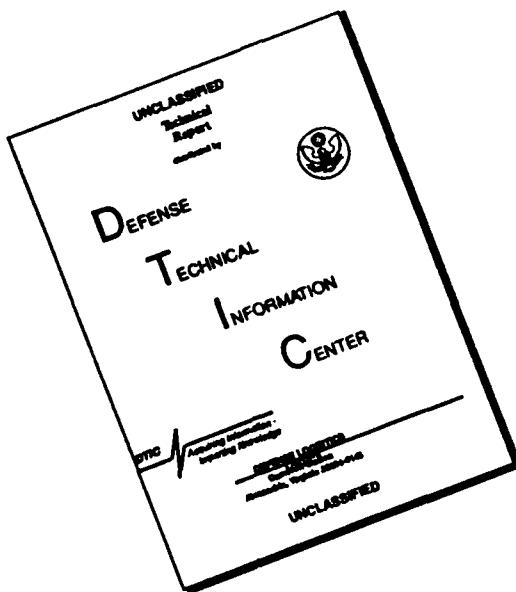


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19 ABSTRACT (Continue on reverse if necessary and identify by block number) Dropped-weight instrumented impact tests were used in conjunction with ultrasonic C-span inspection to characterize the impact response of several new graphite-fiber composite material systems. The AS4/Hercules 3501-6 graphite/epoxy was compared to the newer AS4/Hercules 2220-1, Celion High Strain/Narmco 5425 and IM6/Narmco 5245C systems in the 250° (121°C) service category. Materials tested in the 350°F (177°C) service category were: T300/Avco 130B, T300/Hexcel 81-5, T300/U.S. Polymeric V378A, XAS/Hysol 9102 and HX/Hexcel 1516 graphite/bismaleimides. A material ranking is given along with measured impact parameters and impact energy versus damage relationships. The impact behavior of all four 250°F (121°C) systems were similar except IM6/5245C had the highest impact resistance. The bismaleimides had similar incipient damage levels as the epoxies but were more easily punctured. Impact resistance of the five 350°F (177°C) systems were similar except T300/130B had the lowest impact resistance.				20 DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS											
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FOREWORD

This report presents the instrumented-impact test results for several new composite material systems. This effort is part of the Characterization of Composites Program being performed for the Naval Air Systems Command. Mr. Richard Schmidt is the materials technology administrator. All tests were performed at the Naval Air Development Center. Composite material test specimens were fabricated by Grumman Aerospace Company and the Naval Air Development Center. The authors gratefully acknowledge the contribution to this research effort of Mrs. D. Heal who assisted in the impact testing.

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INTRODUCTION

Graphite-fiber reinforced resin-matrix composites are firmly established as a major aerospace material expected to comprise over half the structural weight of near future aircraft. The wide-spread use and acceptance of graphite/epoxy composites in components of such advanced aircraft as F-18 and AV-8B results from the structural efficiency, extensive characterization and manufacturability of the current, mature systems, such as AS/3501-6 and T300/5208. The epoxy matrixes of these materials, however, have prevented the structural engineer from taking full advantage of the performance improvements possible through the use of graphite-fiber composites. While it is the high tensile strength and modulus of the fiber which is responsible for the strength and stiffness of a composite structure, the matrix is an essential element necessary to maintain fiber alignment, stabilize the fibers against buckling and provide for load transfer between fibers. The current epoxy resins are degraded by environmental moisture, drastically reducing their strength at elevated temperature and limiting their continuous service capabilities to below 250°F(121°C). They are brittle and easily damaged by low velocity impact, in some circumstances incurring substantial internal damage while showing no visual signs of being struck. The designer is thus forced to restrict these composites to load levels far below the capabilities of the fibers to compensate for environmental effects and possible impact damage. Bismaleimide resin systems have provided improved thermal resistance over epoxies but possess the same limitations. The material suppliers have undertaken to address these limitations by formulating new resin systems to provide better impact resistance, higher strain-to-failure, and improved hot-wet strength. The impact characterization described in this paper was one part of a larger overall program fully characterizing several new prepreg systems with respect to their physical and mechanical properties, see reference 1.

The materials being evaluated were divided into two classes based upon operational service temperature. The AS4/Hercules 3501-6 graphite/epoxy was compared to the newer AS4/Hercules 2201-1, Celion High-Strain/Narmco 5245, and IM6/Narmco 5245C toughened epoxy systems in the 250°F(121°C) service category. Materials tested in the 350°F(177°C) service category were: T300/Avco 130B, T300/Hexcel 81-5, T300/U.S. Polymeric V378A, XAS/Hysol 9101-3, and HX/Hexcel 1516 graphite/bismaleimides.

PROCEDURE

Equipment – A Dynatup Model 8200 Drop Tower with Dynatup Model 371 Instrumented Impact System was used for the impact tests, figure 1. Cross-head weight can be varied from 7.0 to 32 pounds and impact velocities up to 25 ft/sec achieved. This tower can impose impact energies in the range from 1 to 320 ft-lb so that the complete spectrum of composite failure mechanisms from incipient damage up to through-penetration can be studied. Impact-force versus time and velocimeter output from the instrumented impact system are captured on a Nicolet Explorer III model 206-2 digital oscilloscope. The cursor trigger feature of the digital oscilloscope simplifies testing as the force-time analog output itself is used to trigger signal capture. Further, the digitized wave form then stored by the oscilloscope is directly output to a Hewlett-Packard HP9826 desktop computer for analysis and data presentation.

Specimen Preparation. Quasi-isotropic, 16 ply laminates with $[\pm 45_2/(0/90)_2]_S$ stacking sequence were fabricated of each material system from which individual, 6 inch square impact test specimens were cut. Nominal specimen thickness was 1/8 inch. All specimens were fabricated from prepreg-tape except the T300/V378A specimens which were made from balanced plain weave cloth.

Procedure. Each plate impact specimen was clamped in the drop tower along its edges between two steel frames leaving a 5 inch by 5 inch square test section. A 1/2 inch radius hemispherical steel

indenter was attached to the cross-head and each specimen was struck once at its center normal to its surface. The cross-head was caught after rebound to prevent multiple impacts. All specimens were inspected by ultrasonic C-scan before and after each test. All testing was performed at room temperature in a laboratory environment. Impact energy was controlled by adjusting the cross-head weight and drop height. Critical parameters determined for comparing the impact response of each type of materials are:

- (1) Load at incipient damage, P_{inc}
- (2) Energy absorbed at incipient damage, E_{inc}
- (3) Maximum load, P_{max}
- (4) Energy absorbed to maximum load, E_{max}
- (5) Total absorbed energy for through-penetration, E_{tot}

A typical instrumented-impact output for a through-penetration test of AS4/3501-6 specimen is shown in figure 2 identifying the various critical loads and energies. While the load and time response is directly measured, the absorbed energy and displacement values are incrementally computed from the measured initial velocity, cross-head mass, and the load-time history using the methods of reference 2.

Three impact energy levels were studied:

- (1) through-penetration (puncture)
- (2) maximum load impact energy, E_{max}
- (3) incipient damage

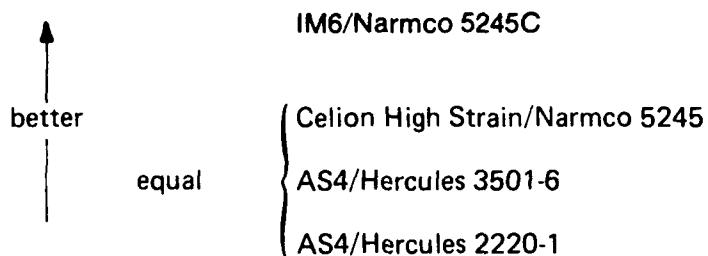
In this manner, a damage gradient is obtained for each prepreg system indicating its response over the entire range of damage mechanisms from incipient to total puncture. Only one test was performed per prepreg system per energy level. Through-penetration instrumented-impact test results were used to establish the peak load energy level. It was not obvious from the through-penetration test results when incipient damage had occurred. In most cases, incipient-damage impact levels could be determined from the peak-load impact energy level test or a lower impact energy level test. In those cases where none of the instrumented impact test traces clearly established incipient damage, it was determined by reducing the impact level until no damage was detectable by ultrasonic C-scan.

RESULTS

Table 1 presents a summary of the critical impact parameters measured during these tests. Table 2 and 3 present the individual test results for the 250°F and 350°F service systems, respectively. Detailed data sheets for each test specimen can be found in the appendix.

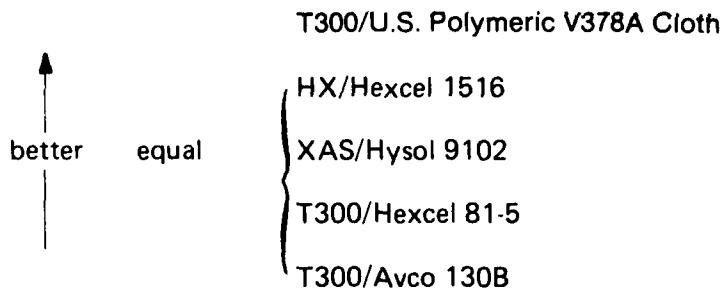
250°F Service Systems. Impact force versus displacement response of the four 250°F systems are plotted in figure 3. Figures 4 and 5 compare the energy and force results, respectively and figure 6 plots the C-scan damage area versus impact energy (cross-head kinetic energy at impact) results. The IM6/Narmco 5245C demonstrated the best impact resistance, requiring nearly twice the energy to cause incipient damage and a third more energy to penetrate as the other systems. There was little difference between the response of the other three materials. In C-scan damage area versus impact energy, the AS4/Hercules 3501-6 sustains the greatest damage at the 10 ft-lb impact level, but at higher energy levels the four systems are similar.

Our ranking of the impact resistance of the 250°F service systems is then:



350°F Service systems. The impact force versus displacement response of the five bismaleimide systems is shown in figure 7. Figures 8 and 9 present the energy and force result comparisons and figure 10 plots the C-scan damage area versus impact energy. Since the T300/U.S. Polymeric V378A test specimens were made from plane-weave cloth, its impact response can not be directly compared to the other, tape layup systems. The use of woven cloth generally results in smaller damage areas as the delamination is inhibited by the direct mechanical reinforcement of the interlocking fabric yarns. Of the tape systems, all had similar impact response, except for the T300/Avco 130B. It experienced incipient damage at a third the energy of the other systems and required only half the energy to be punctured. It also experienced the largest damage areas of all systems tested.

While the incipient damage levels of the better bismaleimides were equal to the lower temperature materials, they were more easily punctured than the latter. Our ranking of the impact resistance of the bismaleimide systems is then:



DISCUSSION

It is normally assumed that the initiation of damage in the composite-plate impact specimen causes a reduction in stiffness which is indicated as a dip in the load-time trace. This point could not always be established from the impact test output due to the presence of higher frequency oscillations on the load analog signal which are the result of dynamic interactions between target-plate and cross-head, figure 1. Further, the initial damage experienced in the matrix of the composite plate may be so slight as to have negligible effect on the bending stiffness and so not appear on the impact test trace. Thus, ultrasonic C-scan inspection was essential to establish the presence of damage and aid in determining the incipient-damage impact level in three of the nine systems tested.

Due to the amount of material needed to fabricate the relatively large test specimens required for drop tower testing, only one impact test was performed per system per energy level. The 6 inch by 6 inch by 1/8 inch specimen size serves both to simulate typical service support conditions and to suppress the higher frequency oscillations present on the force analog output by reducing the

effective stiffness of the target plate relative to the cross-head. Since the same large amount of scatter can be expected in the impact test results as is typically encountered in composite static testing, this is a serious disadvantage.

In ranking the impact resistance of different materials, high resistance to incipient damage clearly is a desirable trait, so too is high maximum load. The maximum load can be interpreted as corresponding to the fiber failure while the incipient damage load corresponds to matrix failure. How the composite should be ranked based upon total absorbed energy, on the other hand, is not so clear cut. The total absorbed energy includes the energy absorbed by the composite in the creation of damage. It also includes the energy lost through the various dissipative mechanisms during the impact event. Such examples are damping in the cross-head and within the specimen and the frictional drag between the tup-shaft and specimen at the edge of the hole created in the specimen during the puncture test. We shall choose to ignore all these effects except for the creation of damage in the specimen. Here again, the use of the ultrasonic C-scan inspection was essential in interpreting the impact test results. Materials which incur large areas of delamination which could reduce a structure's compressive strength are less desirable than those materials which confine the damage to a relatively small area. Materials which absorb little total energy but produce a small, clean hole may be desirable in some applications, providing they also have high initial damage and peak load values. If the structure is such that holes can't be tolerated, then materials which absorb large amounts of energy in the creation of delamination surfaces may be preferable rather than the low velocity impact threat penetrating the component. Generally, the best materials are those which absorb the greatest amount of energy for the least amount of damage. Thus, total absorbed energy is not in itself a useful parameter in ranking material impact response. The extent of damage must also be known along with the type of damage the intended structure can best tolerate.

The incipient damage energy level for the AS4/Hercules 3501-6 is 1.2 foot-pounds. This represents the baseline level from which to assess the improvements achieved by the newer materials. The IM6/Narmco 5245C, which had the highest incipient damage level of the materials tested here, more than doubles this value with an incipient damage energy value of 2.7 foot-pounds. In practical terms, however, a two or three-fold improvement over the 1.2 foot-pounds level still results in an easily damaged material. The designer must still allow for the possibility of sub-visual damage occurring in the structure. Thus, residual strength and fatigue testing of damaged composite specimens is required to fully assess the effects of impact on the structural performance of a composite material system.

CONCLUSIONS AND RECOMMENDATIONS

1. The instrumented-impact testing was performed to make direct comparisons between the impact damage resistance of different composite material systems using geometrically identical test specimens. The through-penetration or puncture test, usually the single impact level investigated with drop-weight impact towers, provides the majority of impact response data, but by itself is insufficient to describe the range of composite damage levels likely to be experienced in service. Nor can it be relied upon to consistently provide incipient-damage impact data. A number of impact energy levels need to be imposed in concert with an adjunct damage measurement method, such as ultrasonic C-scan, to fully describe the impact response.
2. The IM6/Narmco 5245C demonstrated the best impact resistance of the four 250°F service temperature systems tested. The impact resistance of the Celion High-Strain/Narmco 5245, AS4/Hercules 3501-6, and AS4/Hercules 2220-1 were essentially identical.
3. In the 350°F service category, the HX/Hexcel 1516, XAS/Hysol 9101-3, and T300/Hexcel 81-5 had similar impact resistance. The T300/Avco 130B had the lowest impact resistance.

4. The resistance of the bismaleimide composites to incipient damage was similar to that of the lower temperature systems, but the bismaleimides were more easily punctured.
5. The use of fabric composites seems to result in smaller damage areas than those of tape composite laminates.
6. Residual strength testing, particularly compression, needs to be performed in conjunction with instrumented-impact testing to fully assess the structural significance of impact damage in composite material systems.

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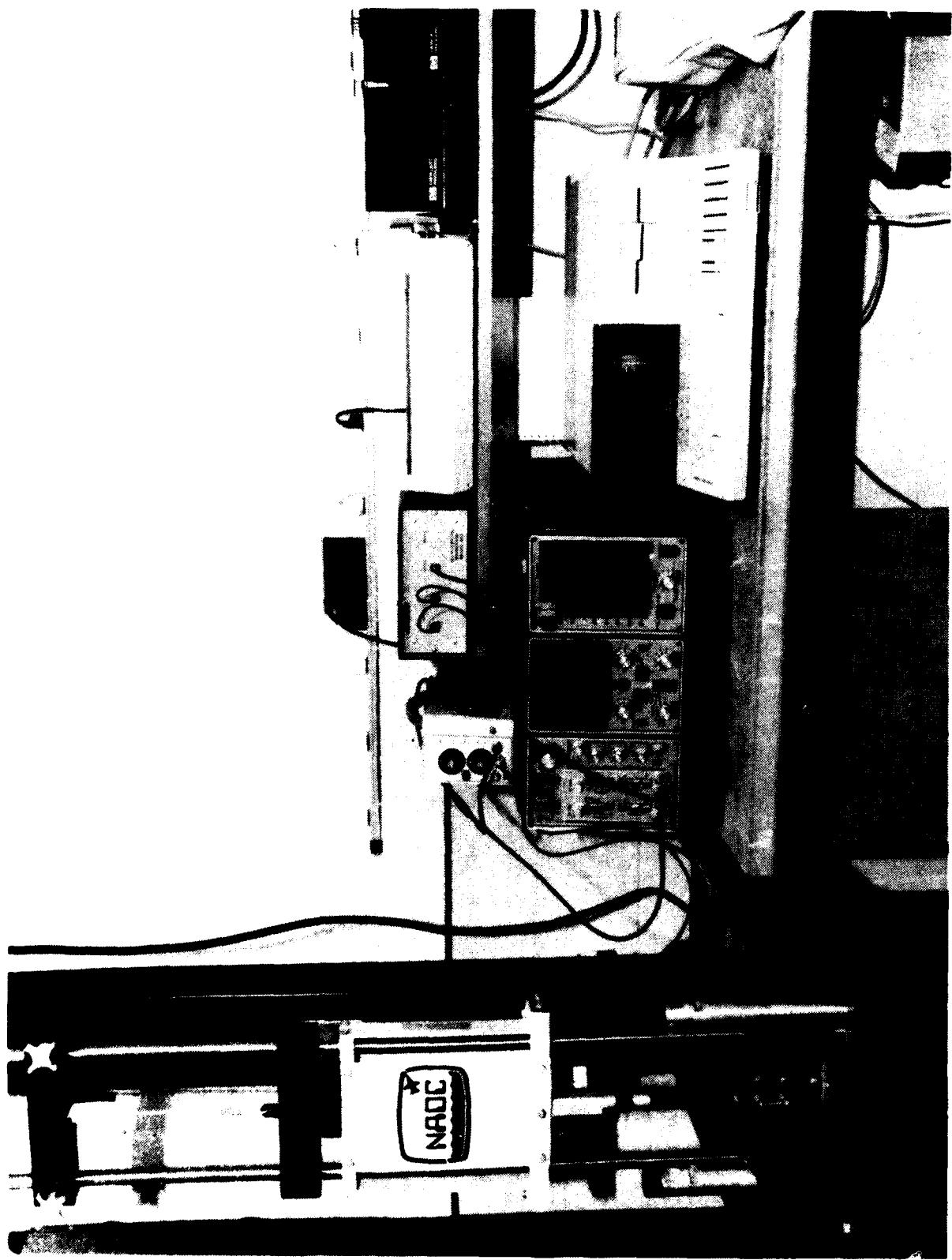


Figure 1. NADC Instrumented Drop Weight System

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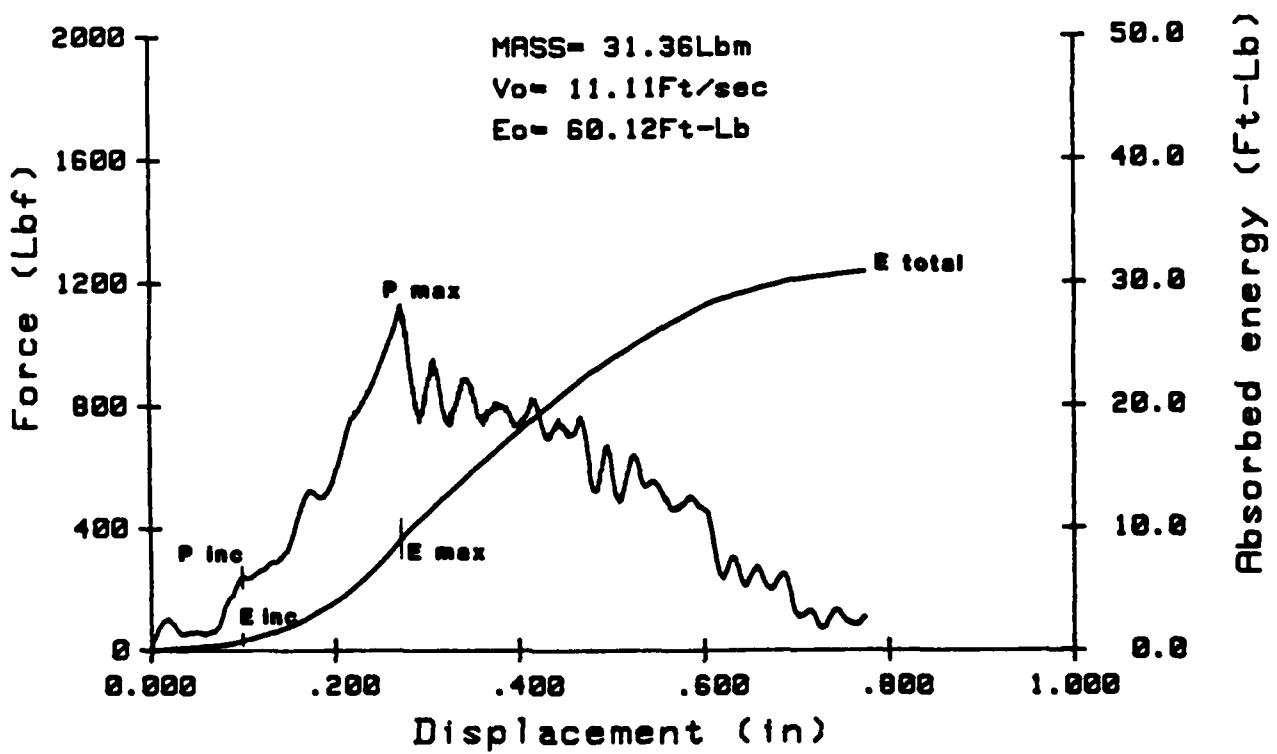
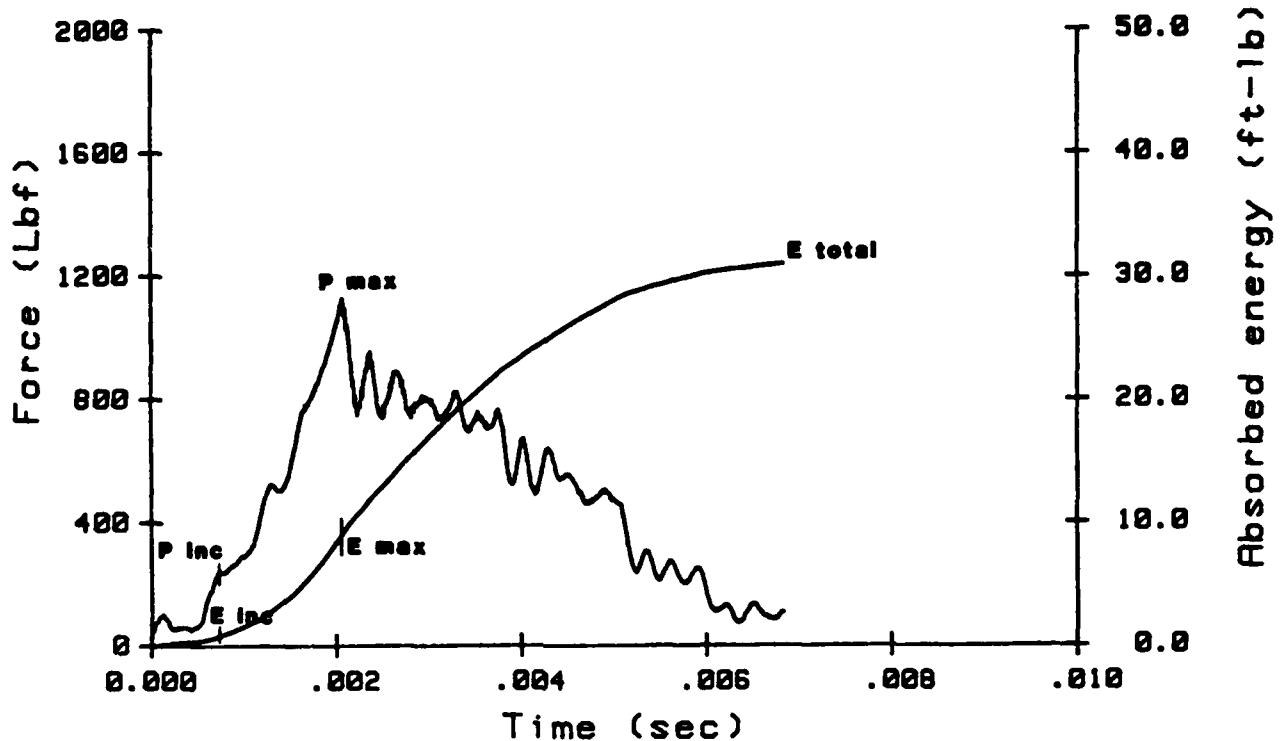


Figure 2. Instrumented Impact Test Output

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1/8 INCH THICK 5X5 INCH CLAMPED PLATES

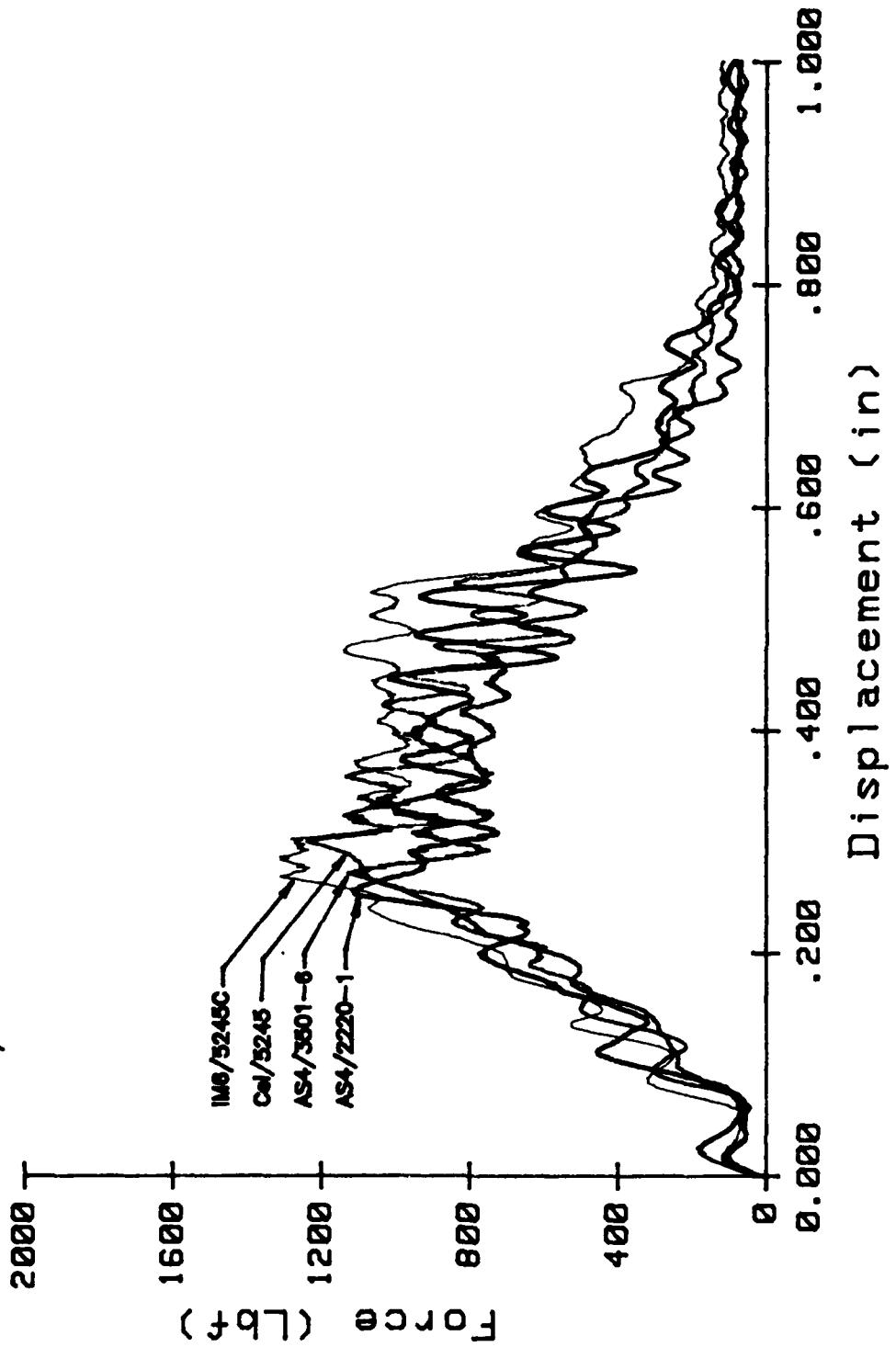
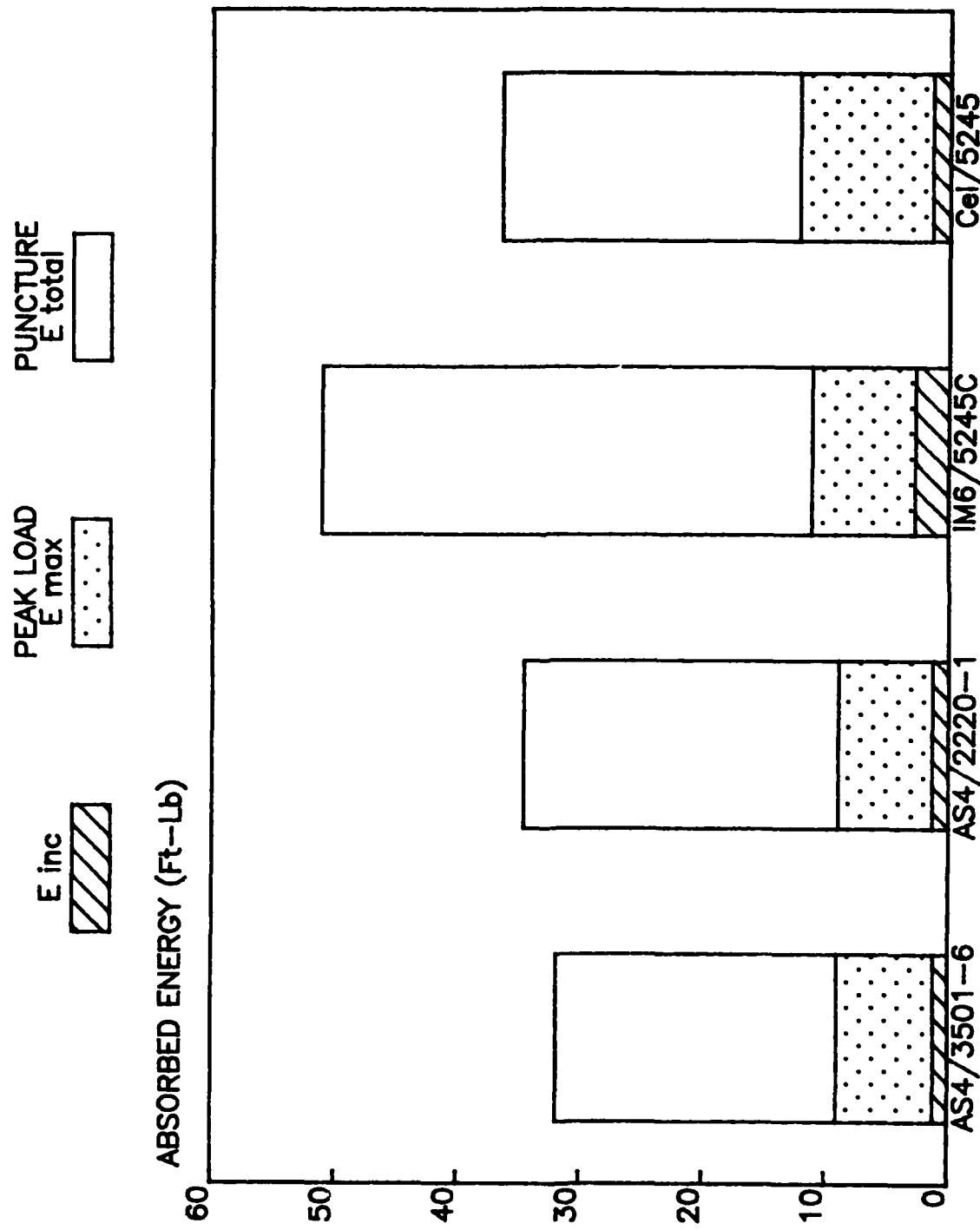
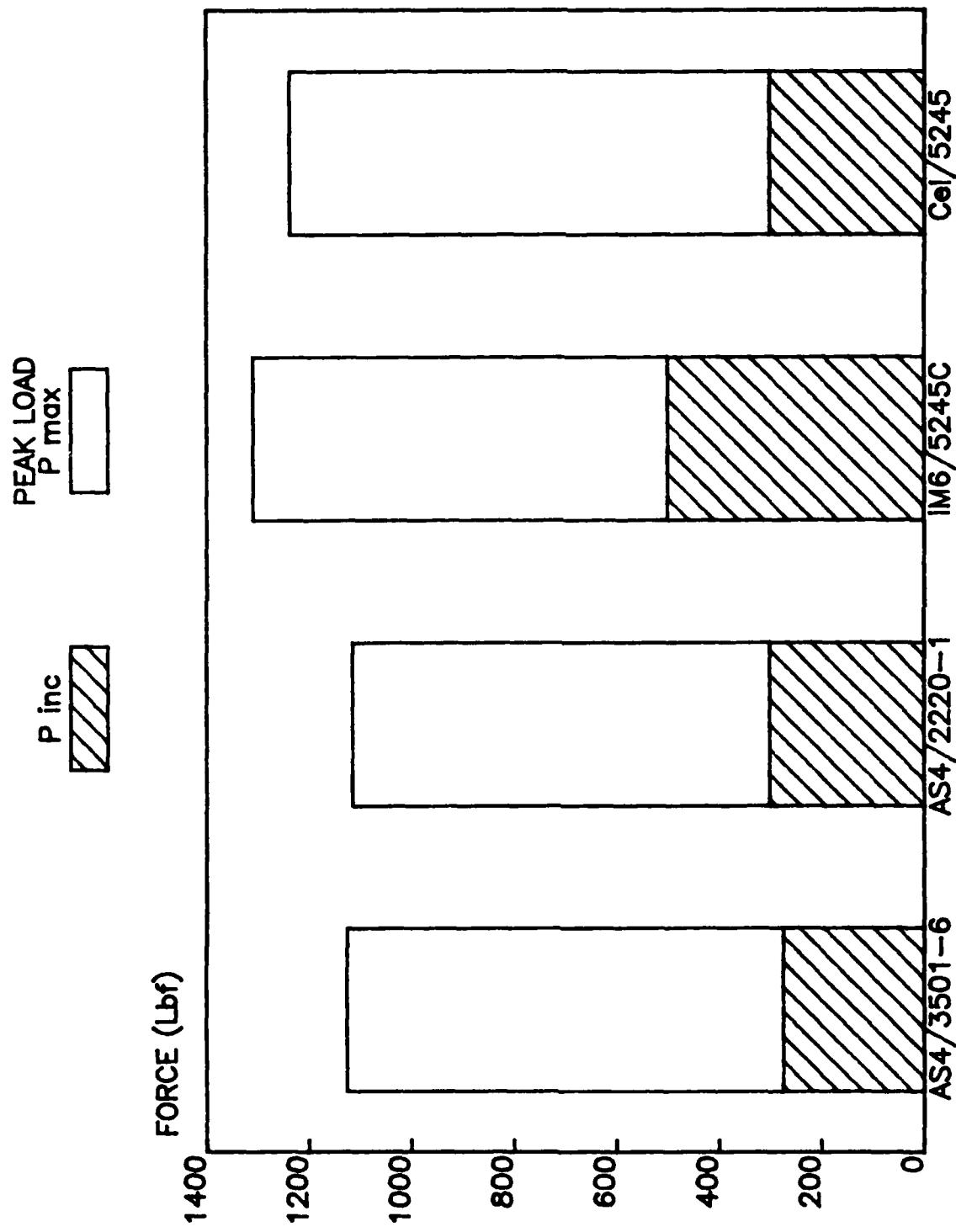


Figure 3. 250°F Service Materials – Impact Force Versus Displacement



1/8 INCH THICK 5X5 INCH CLAMPED PLATES

Figure 4. 250°F Service Materials – Energy Results



1/8 INCH THICK 5X5 INCH CLAMPED PLATES

Figure 5. 250°F Service Materials – Force Results

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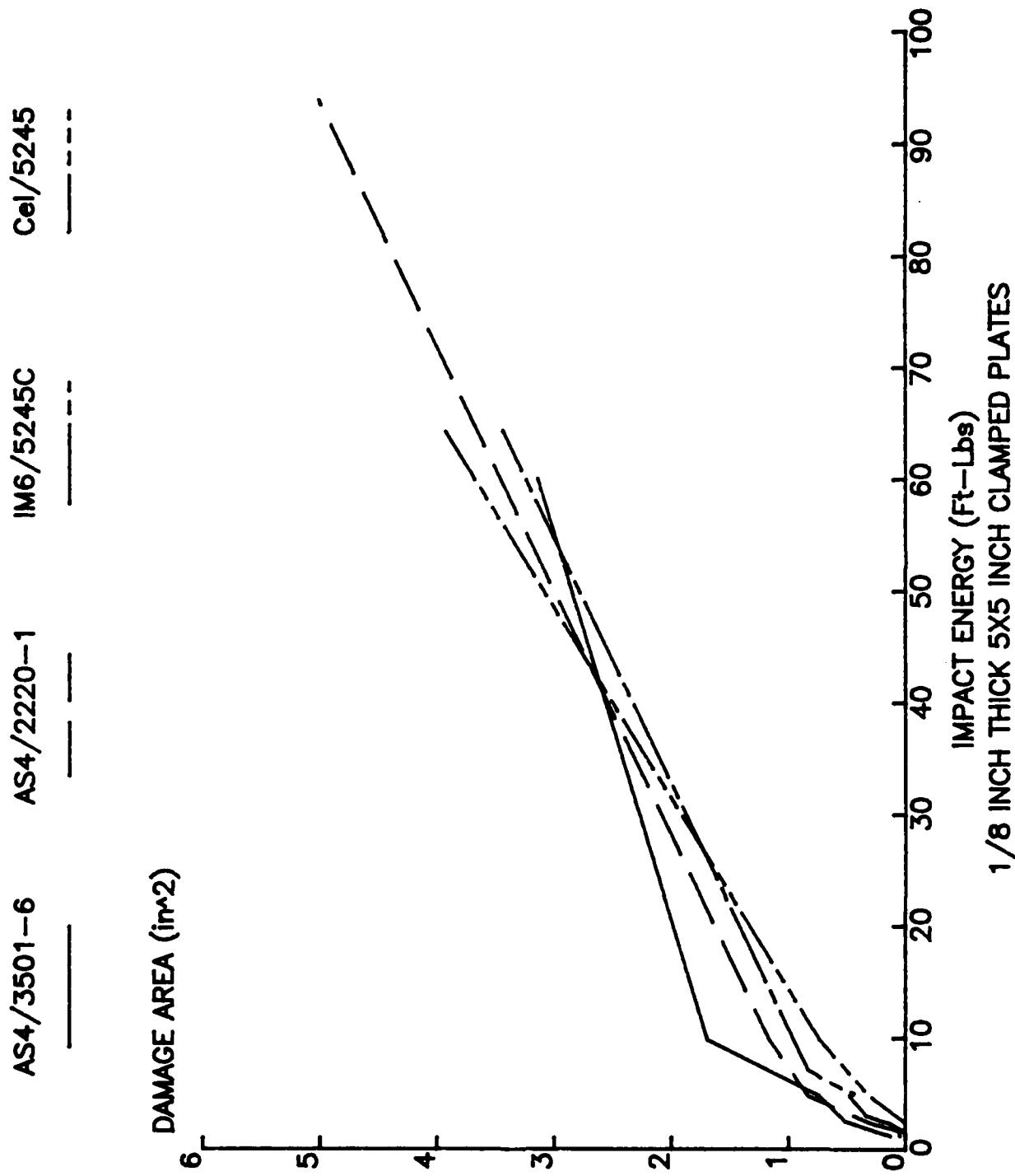


Figure 6. 250°F Service Materials – C-Scan Results

1/8 INCH THICK 5X5 INCH CLAMPED PLATES

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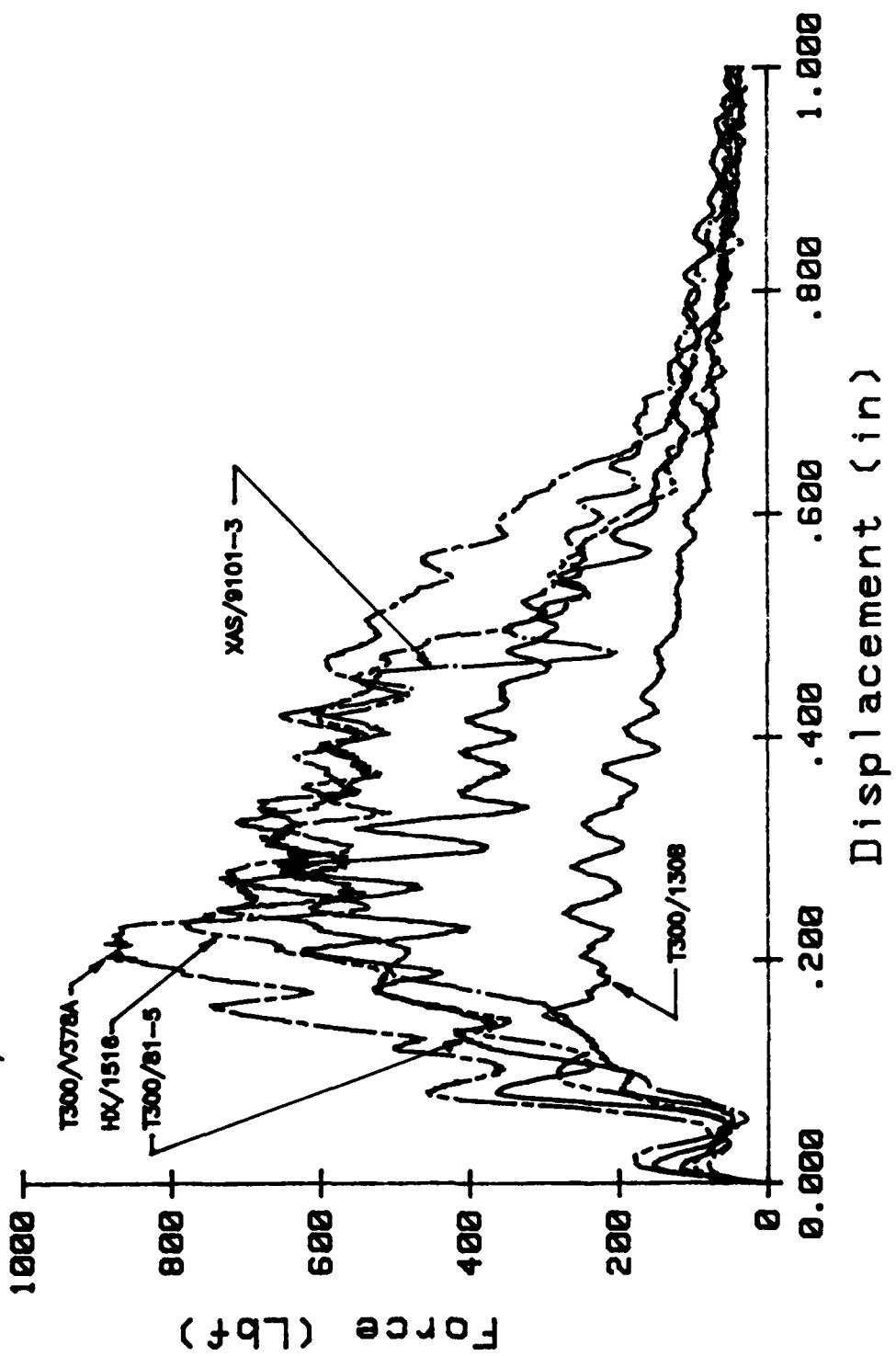


Figure 7. 350°F Service Materials – Impact Force Versus Displacement

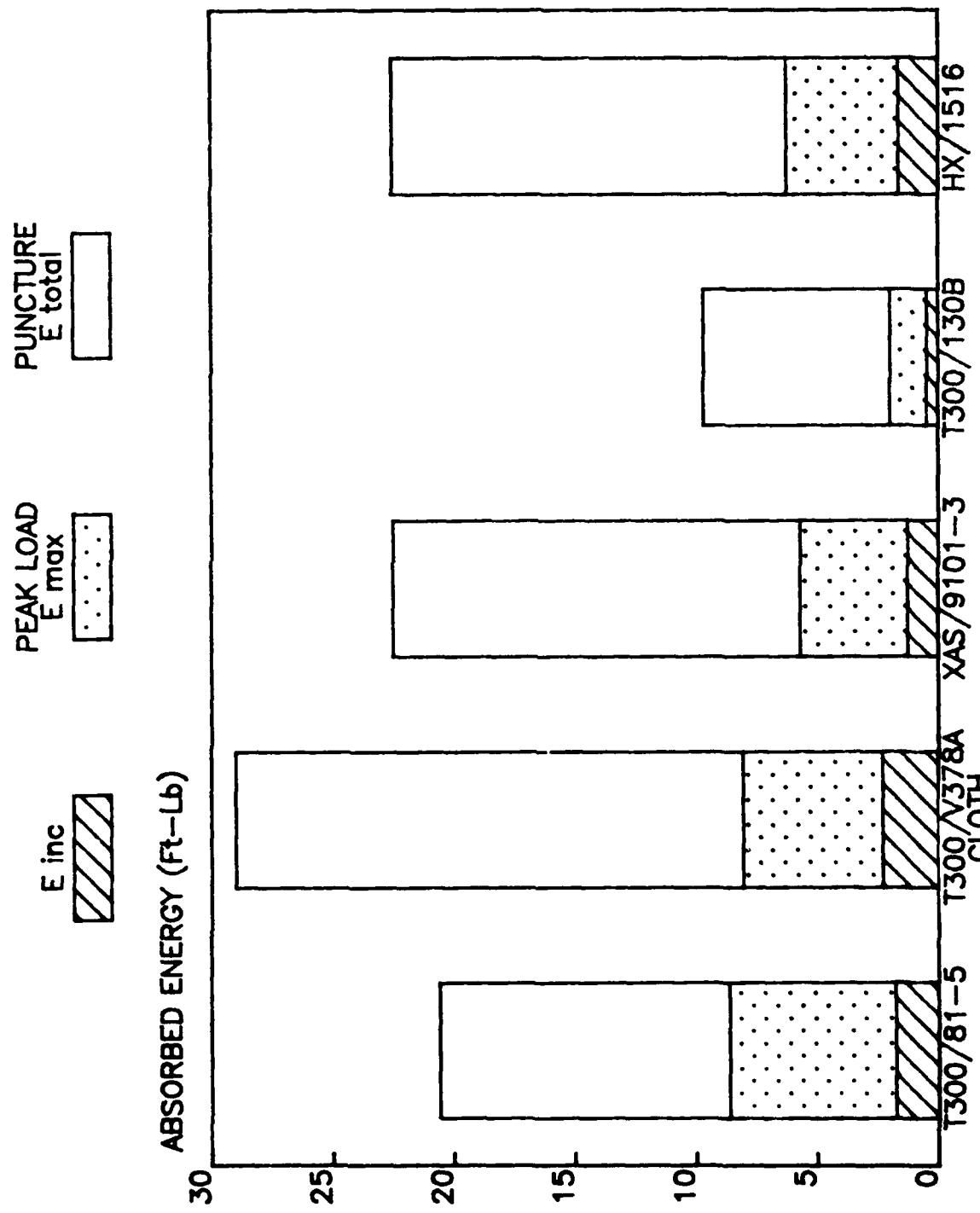
**1/8 INCH THICK 5X5 INCH CLAMPED PLATES**

Figure 8. 350°F Service Materials – Energy Results

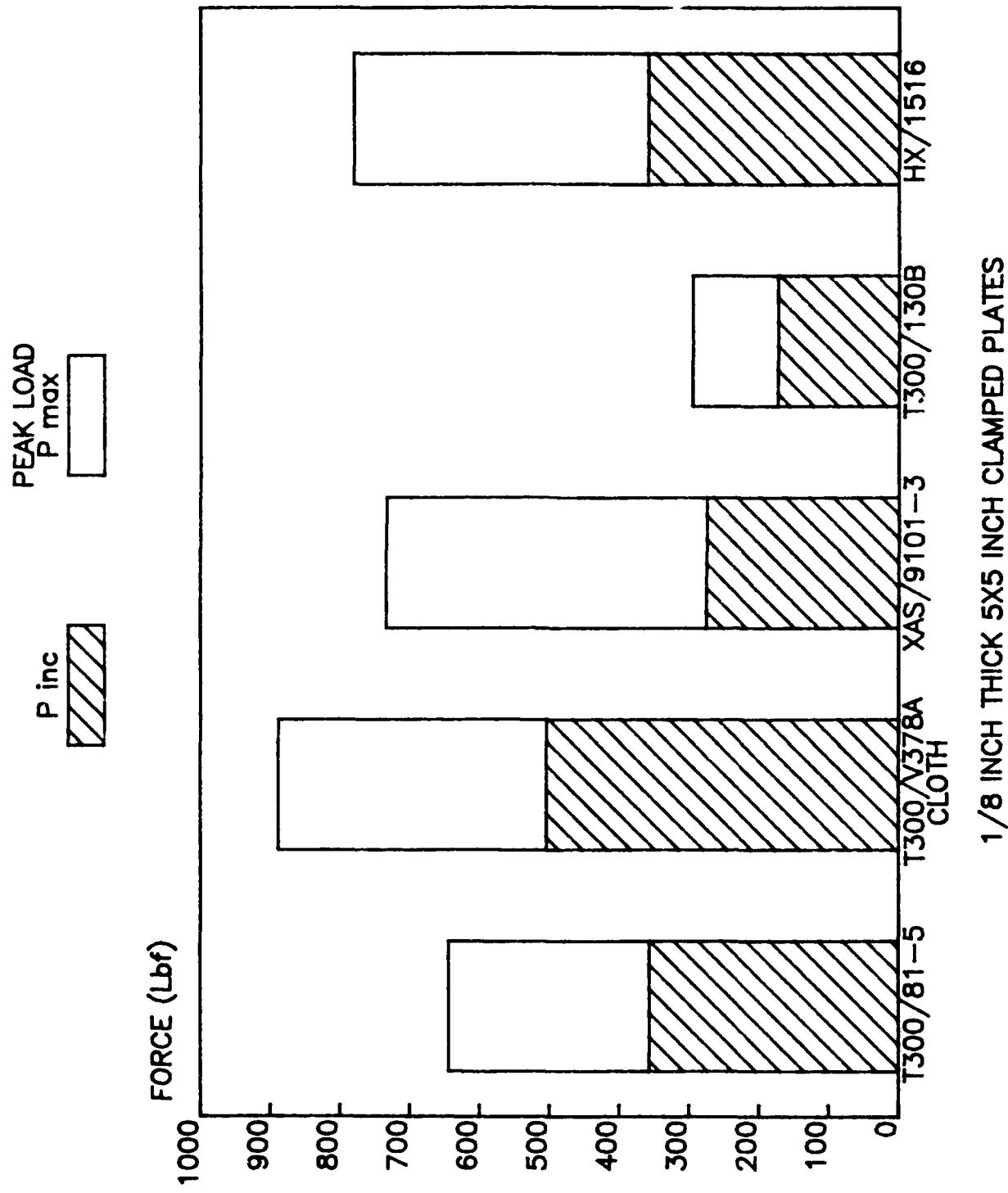


Figure 9. 350°F Service Materials Force Results

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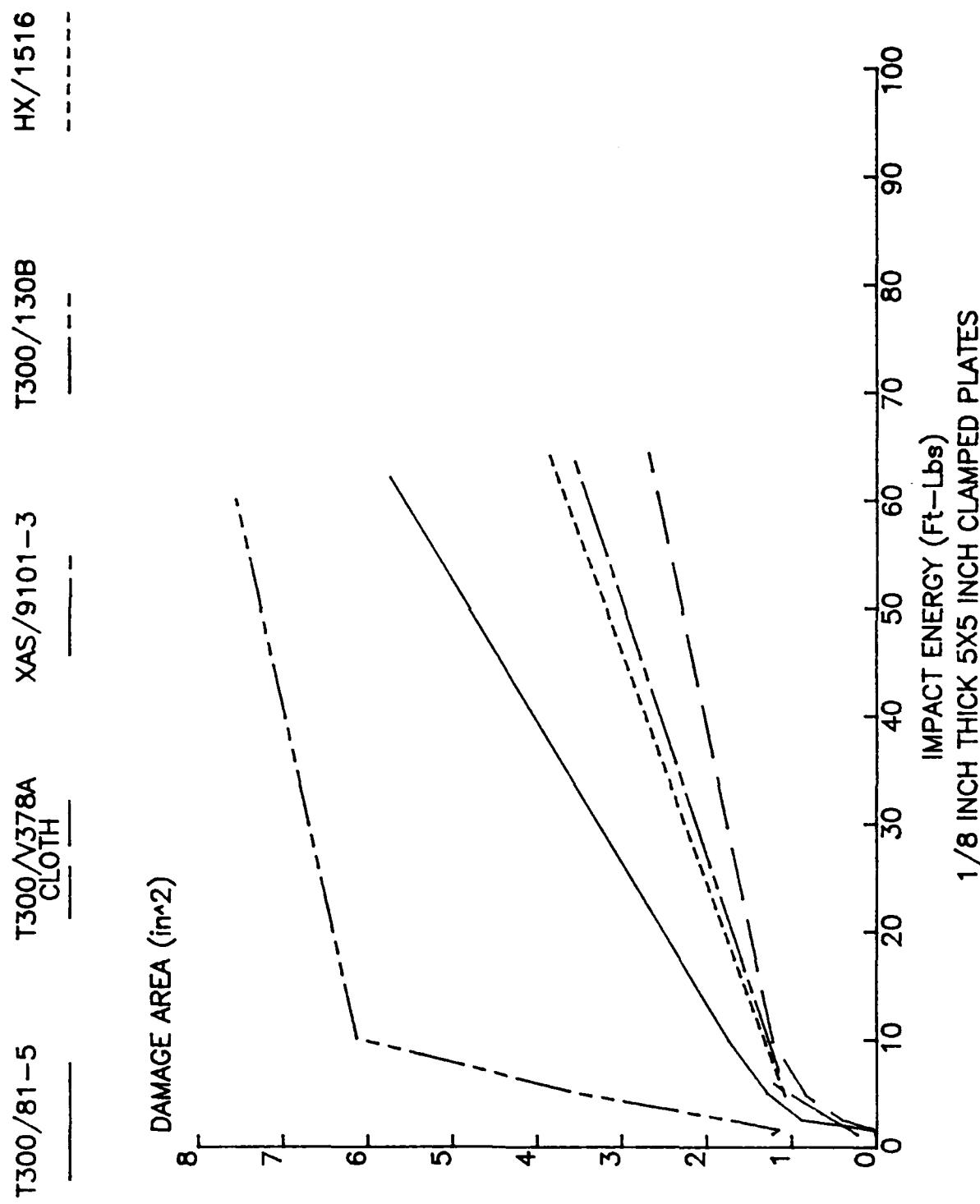


Figure 10. 3050F Service Materials – C-Scan Results

TABLE 1
SUMMARY OF IMPACT RESULTS

	SERVICE TEMP. (F)	AT INCIPIENT DAMAGE			AT MAXIMUM LOAD			TOTAL ENERGY FOR PENETRATION	
		P inc (Lbs)	E inc (Ft-Lbs)	P max (Lbs)	E max (Ft-Lbs)			E total (Ft-Lbs)	E total (Ft-Lbs)
AS4/3501-6	250	274.7	1.19	1125.8	9.07			31.90	
AS4/2220-1		<301.3 *	<1.30 *	1115.1	8.97			37.79	
Col/5245		302.1 *	1.41 *	1237.3	12.21			37.85	
IM6/5245C		500.6	2.71	1309.3	11.14			51.06	
T300/130B	350	172.9	0.48	294.9	1.98			9.69	
T300/81-5		356.3	1.77	643.9	8.63			20.58	
XAS/s101-3		<274.7 *	<1.26 *	733.8	5.71			22.50	
HX/1516		358.8	1.65	780.5	6.26			22.53	
T300/A378A (CLOTH)		504.2	2.30	888.4	8.06			29.00	

* ESTIMATED FROM C-SCAN RESULTS

TABLE 2
2500F SERVICE MATERIALS IMPACT TEST RESULTS

MATERIAL	SPECIMEN NO.	THICKNESS (in.)	IMPACT MASS M lb	VELOCITY V ft/sec	KINETIC ENERGY K.E. ft-lb	AT INITIAL DAMAGE		AT PEAK LOAD		TOTAL ABSORBED ETOT ft-lb	C-SCAN DAMAGE			
						P _{inc} lb	E _{inc} ft-lb	δ _{inc} in	P _{max} lb	E _{max} ft-lb	δ _{max} in	X in	Y in	T XY in ²
ASA/3501-6	8	0.081	7.00	3.38	1.24	*	*	*	277.4	1.31	0.1324	0.48	0.375	0.438 0.129
	7	0.082	7.00	3.83	1.60	*	*	*	313.5	1.62	0.1480	0.75	0.500	0.625 0.245
	4	0.080	7.00	4.83	2.54	274.7	1.19	.1380	423.5	2.62	0.1811	1.13	0.875	0.750 0.515
	3	0.080	7.00	6.67	4.83	*	*	*	663.6	4.87	0.2237	2.04	1.000	0.938 0.737
	2	0.081	7.00	9.52	9.86	*	*	*	1085.4	9.86	0.2983	4.55	1.500	1.438 1.694
	1	0.080	31.36	11.11	60.12	*	*	*	1125.8	9.07	0.2721	31.90	2.000	2.000 3.142
AS4/2220-1	7	0.096	7.00	3.37	1.23	*	*	*	301.2	1.30	0.1171	0.42	0.250	0.250 0.049
	6	0.097	7.00	3.92	1.67	*	*	*	351.2	1.75	0.1387	0.64	0.375	0.188 0.055
	4	0.100	7.00	4.69	2.40	*	*	*	438.4	2.43	0.1632	1.07	0.688	0.563 0.304
	3	0.099	7.00	6.67	4.83	*	*	*	658.2	4.81	0.2055	2.32	1.063	1.000 0.835
	2	0.098	7.00	9.52	9.86	*	*	*	989.2	9.74	0.3039	5.90	1.250	1.188 1.166
	1	0.098	31.36	13.89	93.93	*	*	*	1115.1	8.97	0.2565	37.79	3.000	2.125 5.007
IM6/5245C	6	0.085	7.00	3.35	1.22	*	*	*	291.4	1.22	0.1130	0.57	0	0 0
	5	0.085	7.00	3.92	1.67	*	*	*	372.3	1.71	0.1246	0.64	0.125	0.188 0.019
	9	0.085	7.00	4.63	2.33	*	*	*	453.2	2.38	0.1406	0.97	0.375	0.438 0.123
	10	0.086	7.00	4.63	2.33	*	*	*	440.6	2.39	0.1472	1.01	0.375	0.438 0.126
	4	0.084	7.00	5.29	3.04	*	*	*	510.8	2.90	0.1561	1.54	0.625	0.688 0.338
	7	0.085	7.00	6.67	4.83	519.8	2.82	.1581	680.7	4.88	0.2010	2.31	0.750	0.813 0.479
Puncture	8	0.085	7.00	6.80	5.03	500.0	2.73	.1509	689.7	4.94	0.1975	2.64	0.813	0.688 0.439
	3A	0.083	7.00	7.58	6.24	*	*	*	817.4	6.34	0.2314	2.94	0.875	1.000 0.687
	2	0.086	7.00	8.13	7.18	482.0	2.59	.1558	848.9	6.96	0.2390	4.14	1.063	1.000 0.835
	1	0.085	31.36	11.49	64.34	*	*	*	1309.3	11.14	0.2692	51.06	2.000	2.188 3.437
	7	0.085	7.00	3.12	1.05	*	*	*	260.3	1.13	0.1240	0.41	0	0 0
	6	0.084	7.00	3.88	1.63	*	*	*	343.9	1.70	0.1446	0.60	*	* *
Cell e/5245	1	0.084	7.00	4.76	2.46	*	*	*	451.0	2.55	0.1723	0.93	0.08	0.10 0.006
	2	0.086	7.00	6.67	4.83	*	*	*	672.6	4.91	0.2260	2.13	0.625	0.625 0.307
	3	0.086	7.00	9.52	9.86	*	*	*	1034.1	9.94	0.2853	5.34	1.000	0.938 0.7367
	4	0.085	31.36	11.49	64.34	*	*	*	1237.3	12.21	0.3009	37.85	2.500	2.000 3.927

*UNABLE TO DETERMINE FROM RESULTS

TABLE 3
350°F SERVICE MATERIALS IMPACT TEST RESULTS

MATERIAL	SPECIMEN NO.	IMPACT MASS M lb	VELOCITY V ft/sec	KINETIC ENERGY KE ft-lb	AT INITIAL DAMAGE			AT PEAK LOAD			TOTAL ABSORBED ETOT ft-lb	X in	Y in	$\frac{\pi}{4}XY$ in ²	C-SCAN DAMAGE
					P _{inc} lb	E _{inc} ft-lb	δ _{inc} in	P _{max} lb	E _{max} ft-lb	δ _{max} in					
T300/81-5	11	0.097	7.00	3.27	1.16	*	*	287.8	1.21	0.1133	0.47	0	0	0	
	7	0.085	7.00	3.88	1.63	231.8	1.03	0.1216	273.9	1.71	0.1571	0.94	0.188	0.250	0.037
	5	0.097	7.00	4.63	2.33	344.0	1.54	0.1220	392.1	2.07	0.1417	1.33	0.938	0.938	0.691
	4	0.097	7.00	4.83	2.54	387.6	1.83	0.1210	426.2	2.10	0.1300	*	1.063	1.063	0.888
	3	0.100	7.00	6.80	5.03	398.4	1.89	0.1234	584.5	4.85	0.2027	3.25	1.250	1.313	1.289
	2	0.102	7.00	9.52	9.86	419.9	2.56	0.1530	597.1	7.01	0.2582	8.95	1.313	1.688	1.741
Puncture	1	0.098	31.36	11.30	62.17	*	*	643.9	8.63	0.2853	20.58	3.000	2.438	5.744	
T300/V378A (Cloth)	6	0.110	7.00	3.38	1.24	*	*	347.6	1.28	0.0950	0.45	—	—	—	
	5	0.111	7.00	4.02	1.75	*	*	411.0	1.71	0.1131	0.71	0.250	0.250	0.049	
	4	0.110	7.00	4.83	2.54	473.0	2.29	0.1235	521.1	2.49	0.1288	1.33	0.688	0.750	0.405
	3	0.110	7.00	6.67	4.83	516.2	2.15	0.1162	649.2	4.92	0.1778	2.58	1.000	1.063	0.835
	2	0.111	7.00	9.52	9.86	523.4	2.46	0.1224	787.7	6.82	0.2062	7.80	1.250	1.250	1.227
	1	0.110	31.36	11.49	64.34	*	*	888.4	8.06	0.2163	29.00	1.85	1.85	2.688	
XAS/9101-3	5	0.077	7.00	3.17	1.10	*	*	234.3	1.13	0.1346	0.72	*	*	*	
	6	0.077	7.00	3.30	1.18	*	*	274.7	1.25	0.1351	0.49	0.563	0.500	0.221	
	4	0.076	7.00	5.38	3.14	*	*	464.5	3.15	0.1961	1.74	0.875	0.938	0.645	
	3	0.075	7.00	7.41	5.96	*	*	766.1	5.54	0.2450	3.02	1.188	1.313	1.225	
	2	0.077	7.00	8.13	7.18	*	*	741.0	5.86	0.2441	5.57	1.313	1.125	1.160	
	1	0.076	31.36	11.49	64.34	*	*	733.8	5.71	0.2483	22.50	2.438	1.875	3.590	
T300/130B	6	0.086	7.00	3.37	1.23	159.2	.43	0.0801	234.7	1.26	0.1383	0.68	1.188	1.313	1.225
	5	0.085	7.00	3.88	1.63	182.4	.54	0.0861	266.9	1.63	0.1526	1.01	1.125	1.313	1.160
	4	0.084	7.00	4.73	2.43	177.1	.42	0.0595	265.3	2.14	0.1653	2.14	1.688	1.250	1.657
	3	0.086	7.00	6.80	5.03	*	*	*	265.3	1.91	0.1447	5.17	2.313	1.938	3.521
	2	0.088	7.00	9.66	10.15	*	*	*	291.4	3.11	0.2167	8.94	3.125	2.500	6.136
	1	0.086	31.36	11.11	60.12	*	*	*	294.9	1.98	0.1553	9.69	3.500	2.750	7.560
HX/1516	2	0.083	7.00	6.67	4.83	358.8	1.65	0.1299	632.2	4.76	0.2111	2.63	1.188	1.188	1.085
	1	0.084	31.36	11.49	64.34	*	*	*	780.5	6.26	0.2327	22.53	2.625	1.875	3.866

*UNABLE TO DETERMINE FROM RESULTS

APPENDIX A

Instrumented Impact Test Data Sheets

and

C-Scan Results

Material System	Page
AS4/3501-6	A-2
AS4/2220-1	A-16
Celion high strain/5245	A-30
IM6/5245C	A-44
T300/81-5	A-66
T300/V378A Cloth	A-82
XAS/9101-3	A-95
T300/130B	A-108
HX/1516	A-122

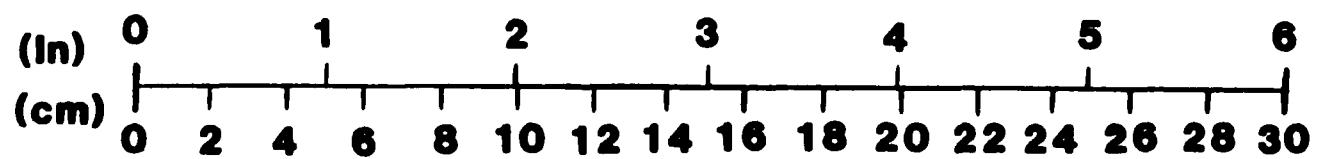
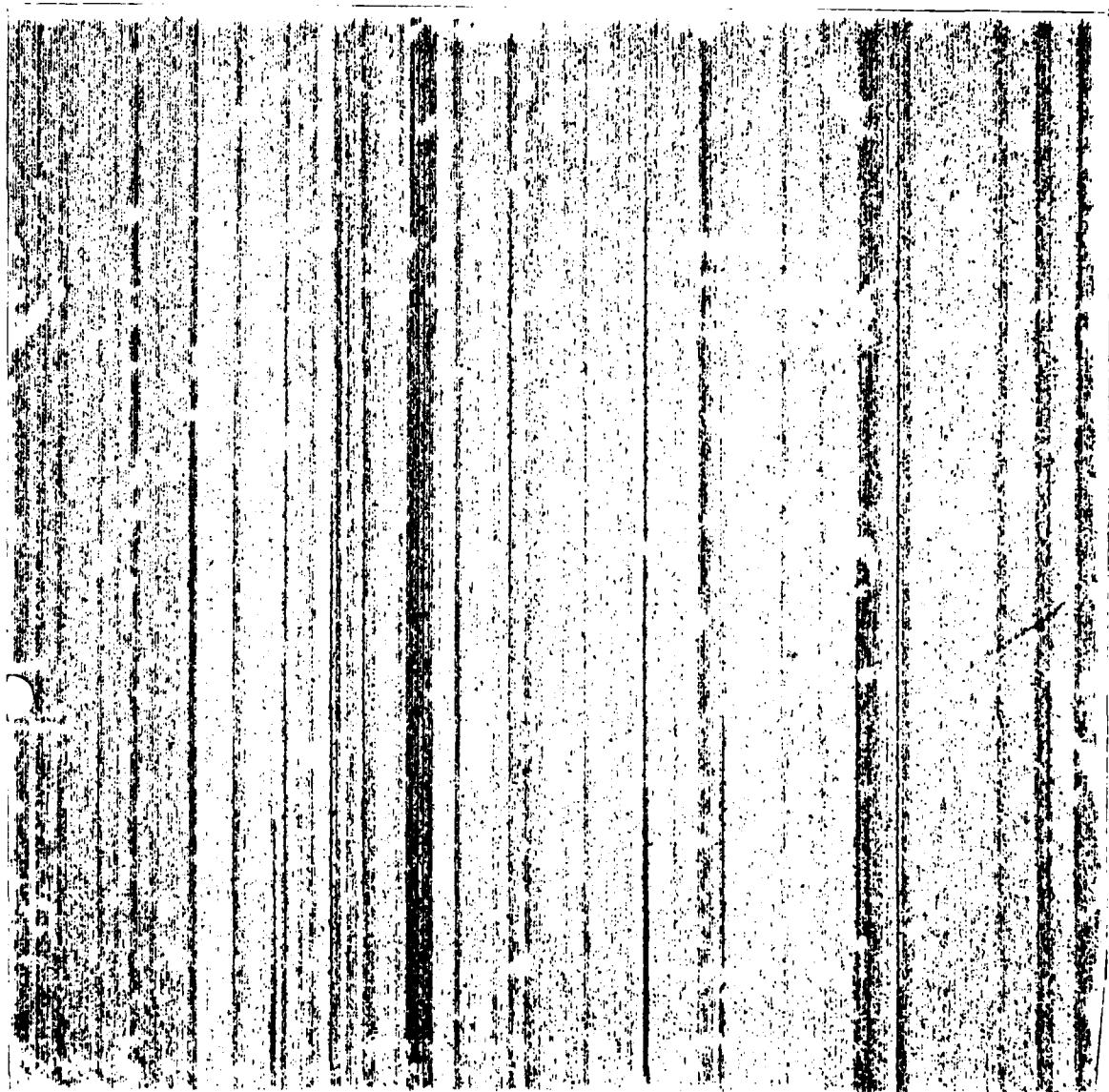
NADC-85023-60

AS4/3501-6

NADC-85023-60

AS4/3501-6

#15

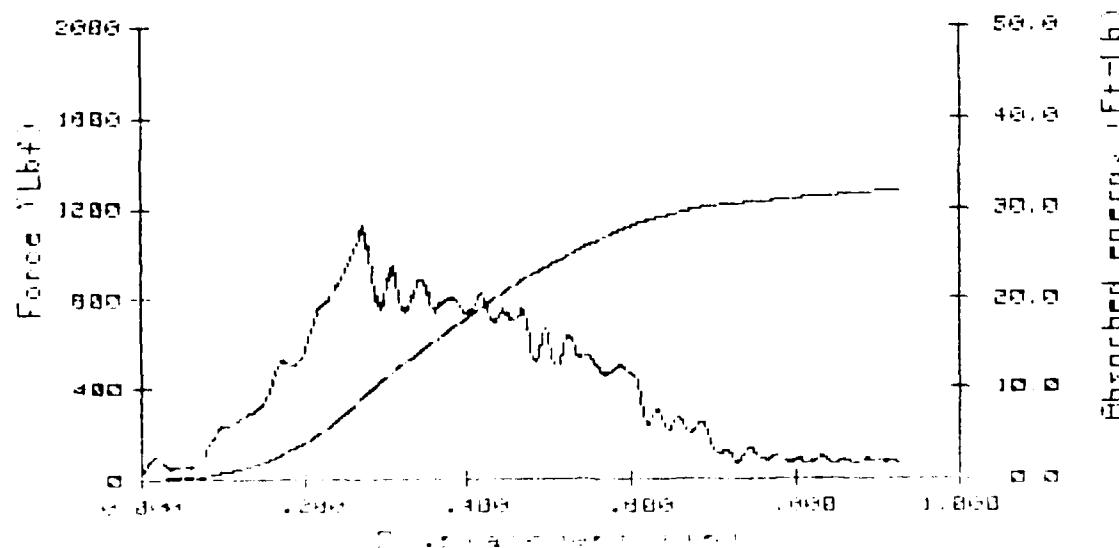
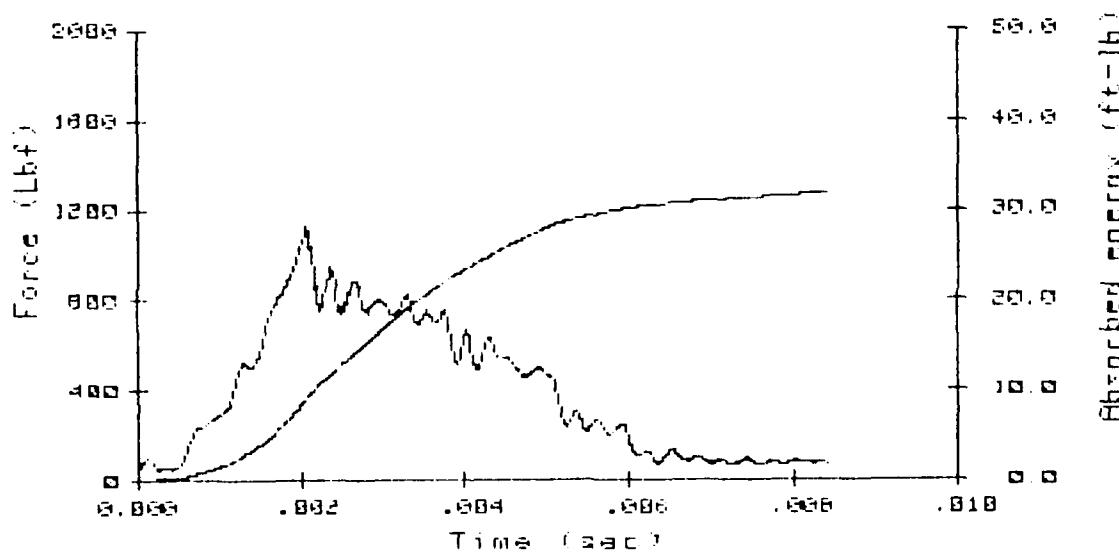


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INSTRUMENTED IMPACT TEST
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GR/EP 3501-6 #1

Drop weight = 31.36Lb Data disk MAT00804
 Tup radius = .500in DRM scale .8In/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 11.11ft/s
 K.E. = 60.12ft-Lb $V_f(\text{calc})$ = 7.93ft/s

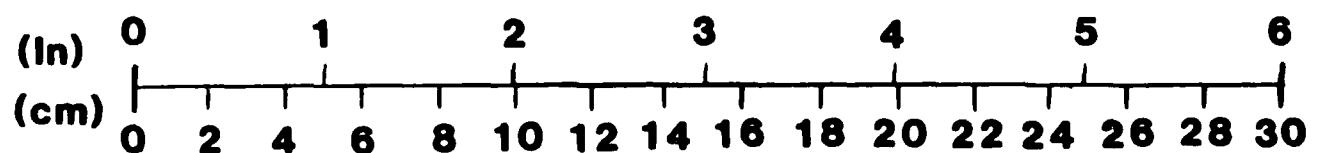
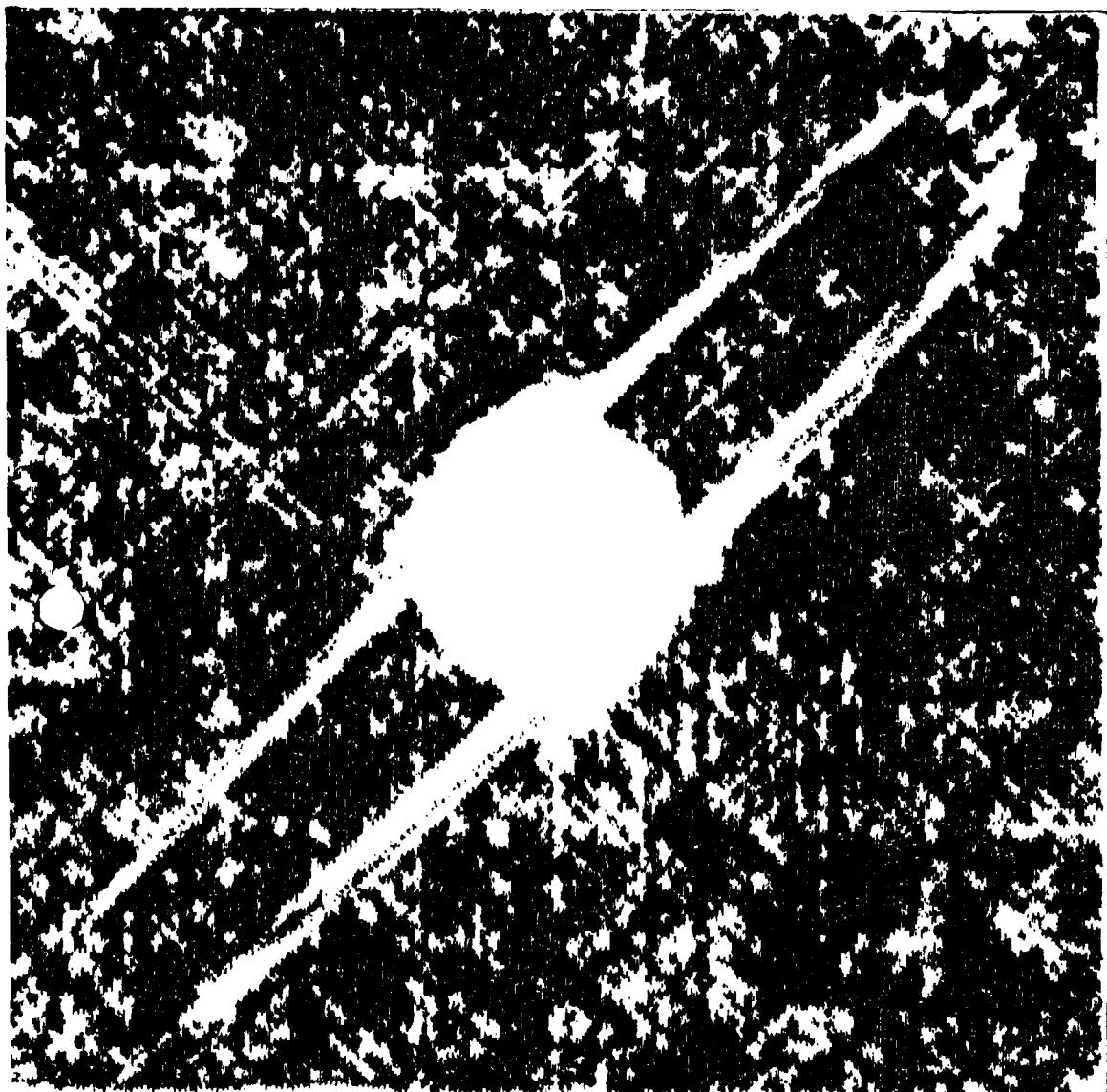
Load(Lb)	Time(s)	$E_0(\text{Ft-Lb})$	Disp(in)	
1125.8	2.065E-3	9.07	.2721	Maximum force
73.7	8.415E-3	31.90	.9260	Maximum energy
73.7	8.415E-3	31.90	.9260	Maximum displacement
73.7	8.415E-3	31.90	.9260	Final values



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#1



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NADC/ETI-8200 DROP TEST FACILITY

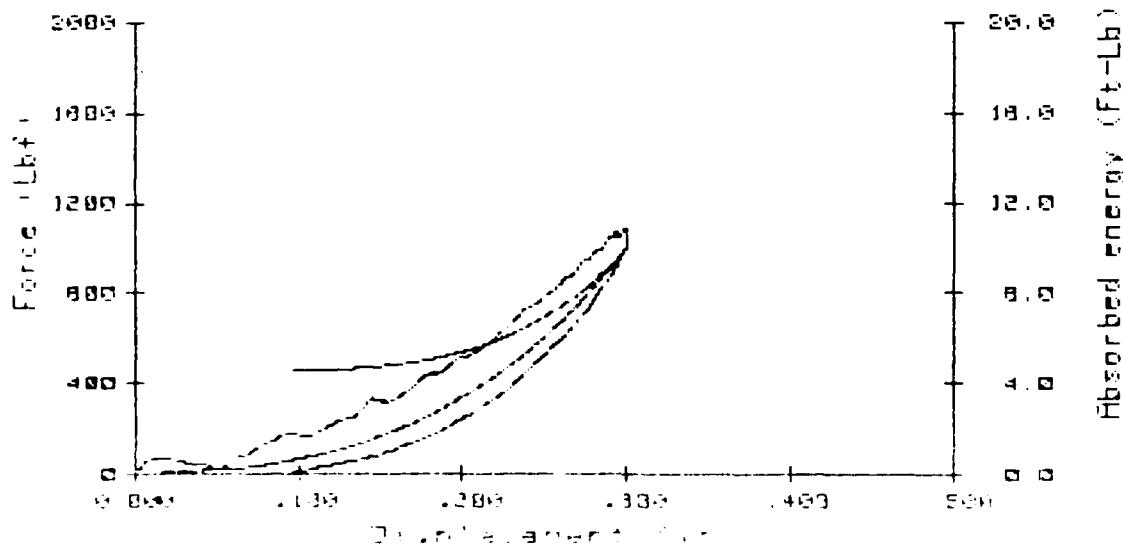
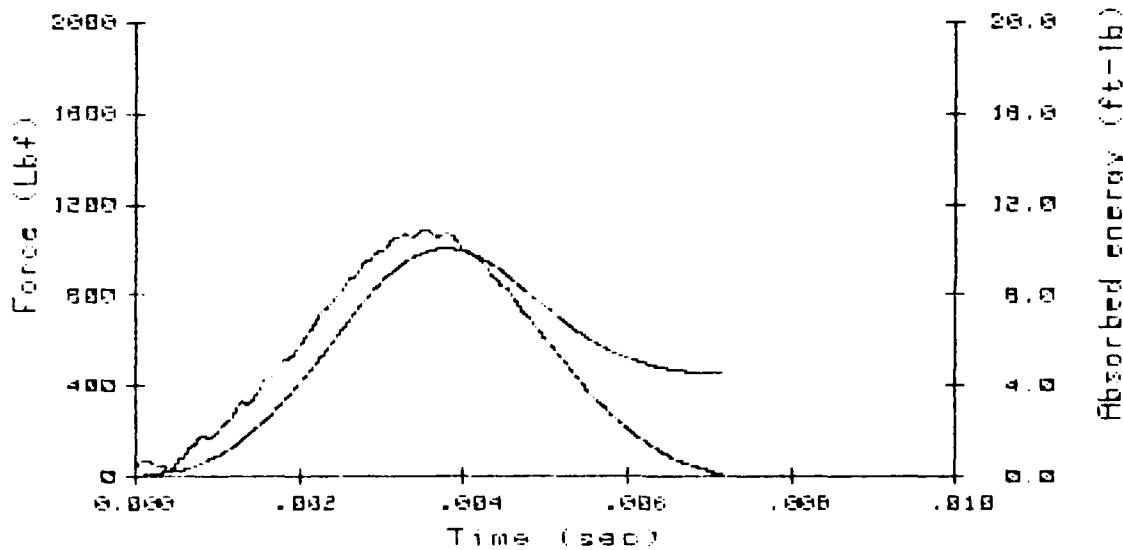
1/31/84

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INSTRUMENTED IMPACT TEST
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GR/EP 3501-6 #2

Drop weight = 7.00Lb Data disk MAT00803
 Tup radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid = .040in
 VO = 9.52ft/s abs(Vf) = 8.55ft/s
 K.E. = 9.86ft-Lb Vf(calc) = -7.03ft/s

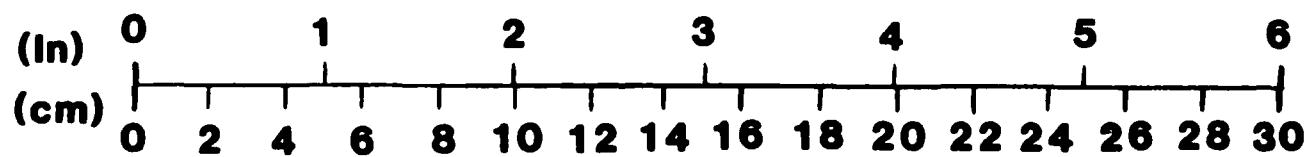
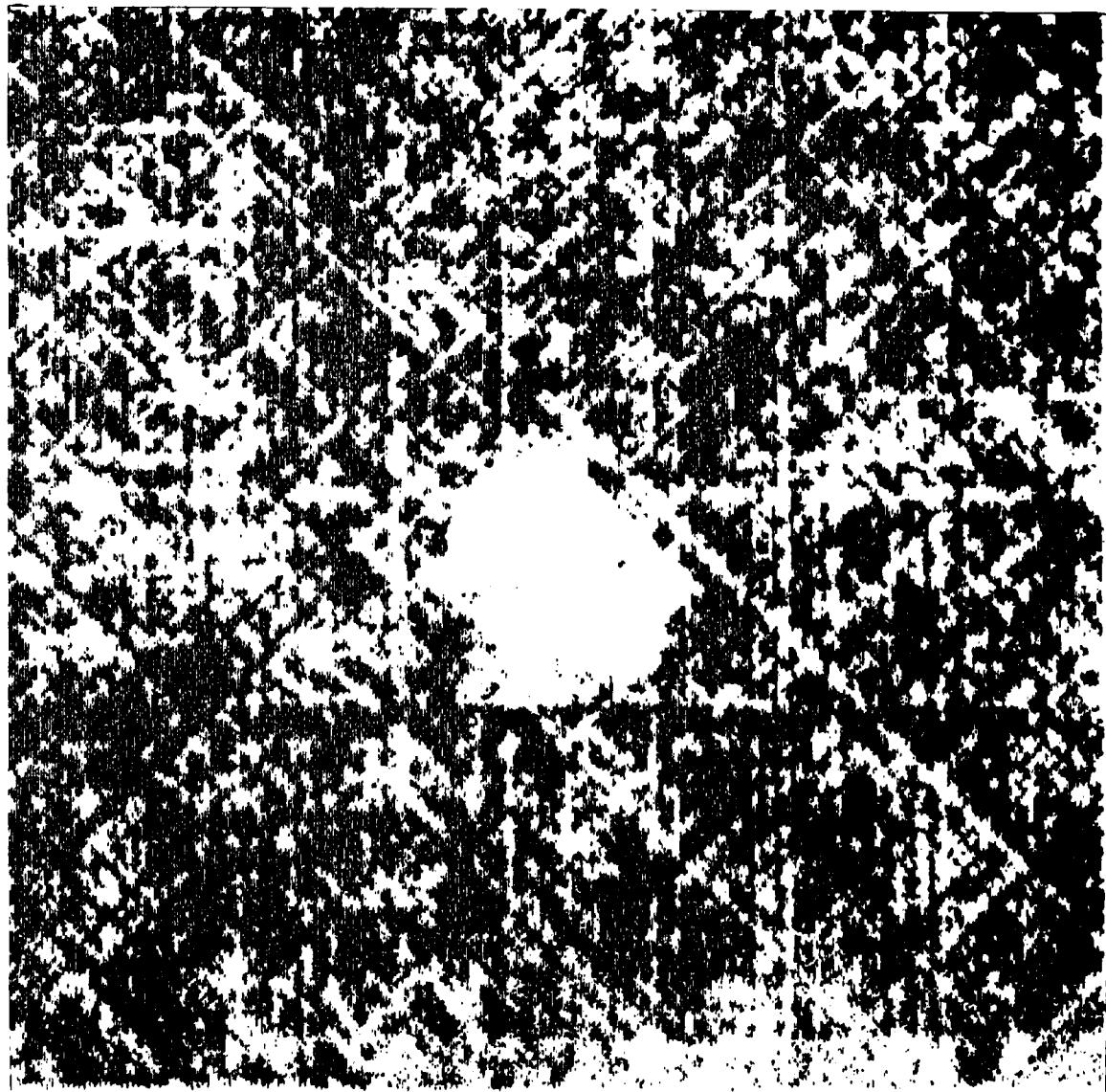
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
1085.4	3.505E-3	9.86	.2983	Maximum force
1070.1	3.765E-3	10.03	.3002	Maximum energy
1070.1	3.765E-3	10.03	.3002	Maximum displacement
7.2	7.135E-3	4.55	.0963	Final values



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#2



AETI-SIMON DROP TEST FACILITY

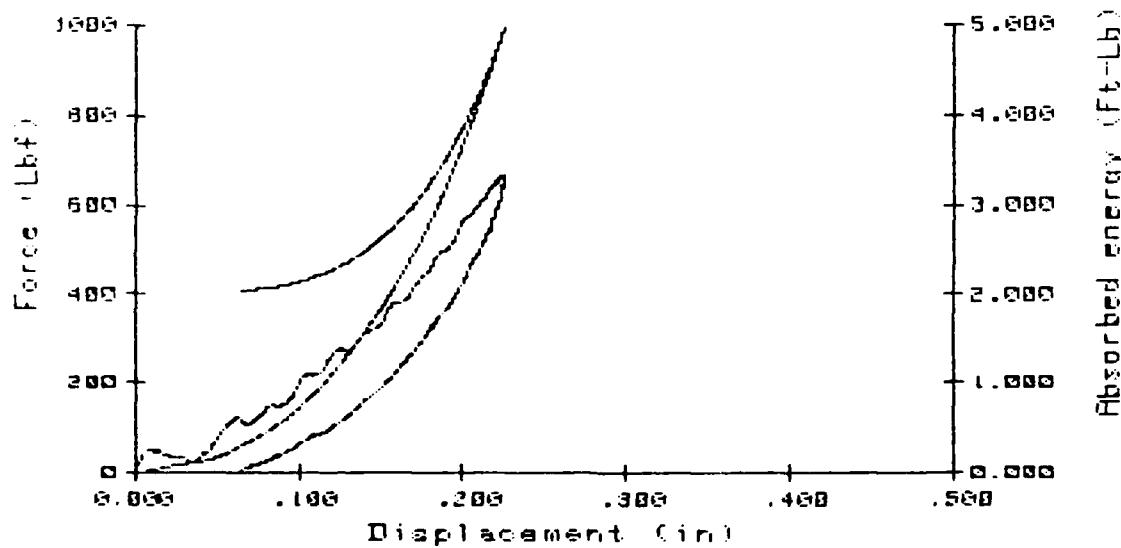
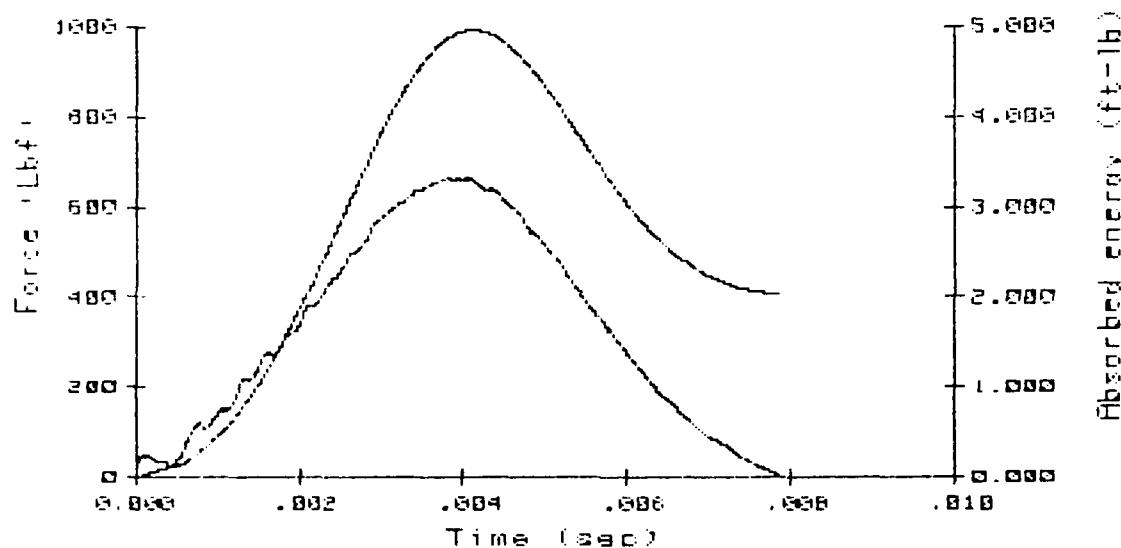
1 01 84

INSTRUMENTED IMPACT TEST

GR/EPI CS01-6 #3

Drop weight = 7.00Lb Data disk MAT00802
 Tup radius = .500in DRM scale .4kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 6.67ft/s abs(V_f) = 6.17ft/s
 E.E. = 4.83ft-Lb V_f (calc) = -5.10ft/s

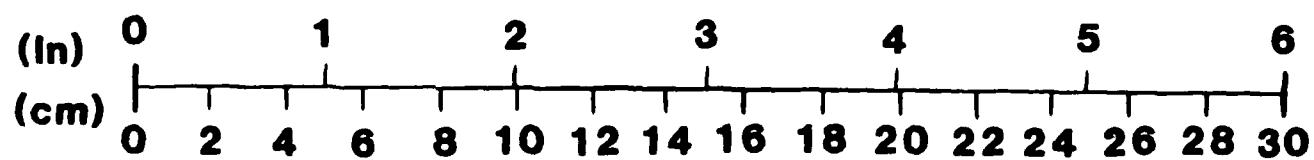
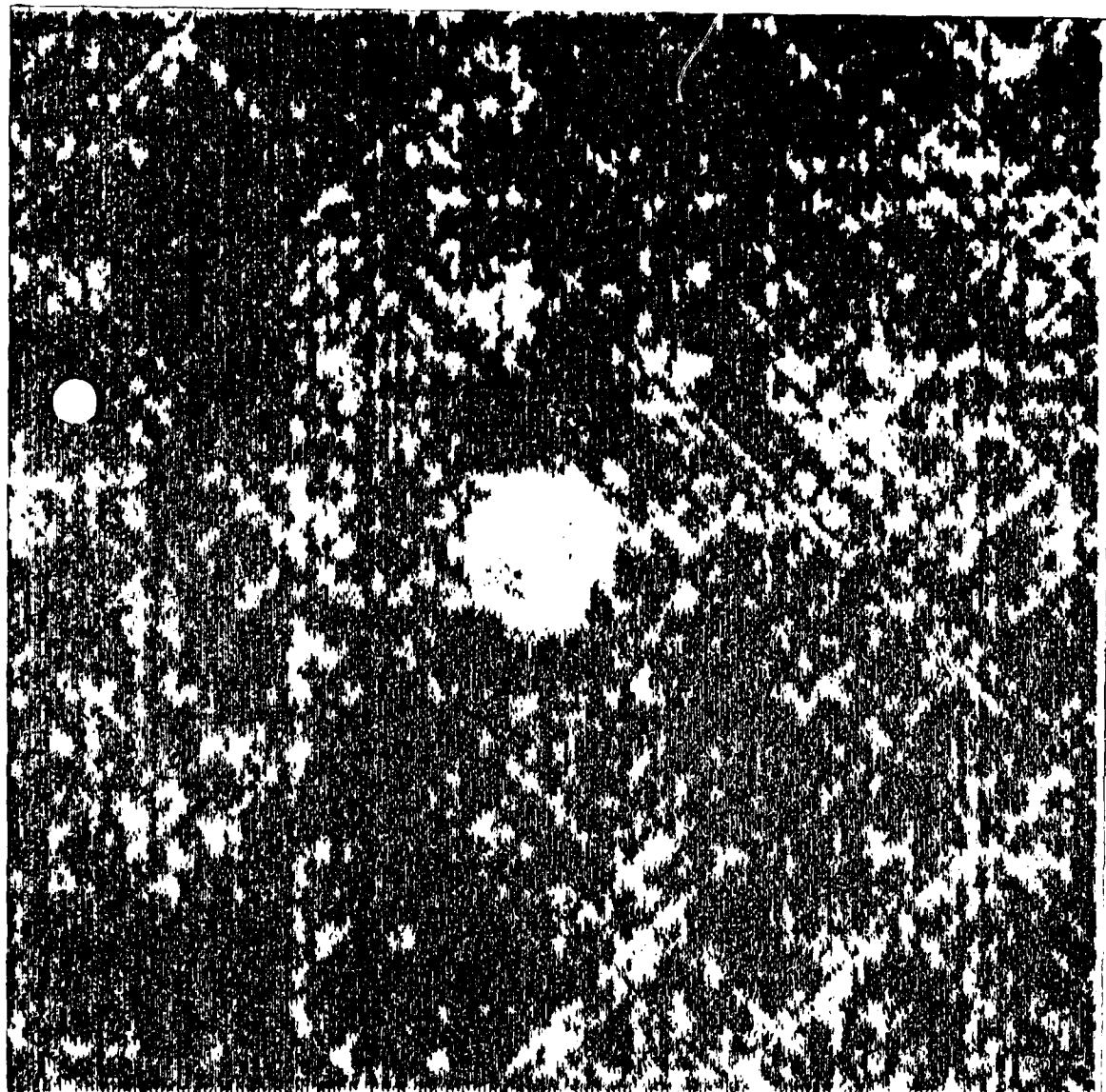
Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
663.6	3.805E-3	4.87	.2237	Maximum force
658.2	4.115E-3	4.96	.2254	Maximum energy
658.2	4.115E-3	4.96	.2254	Maximum displacement
7.2	7.835E-3	2.04	.0652	Final values



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GR/EP 3501-6

#3

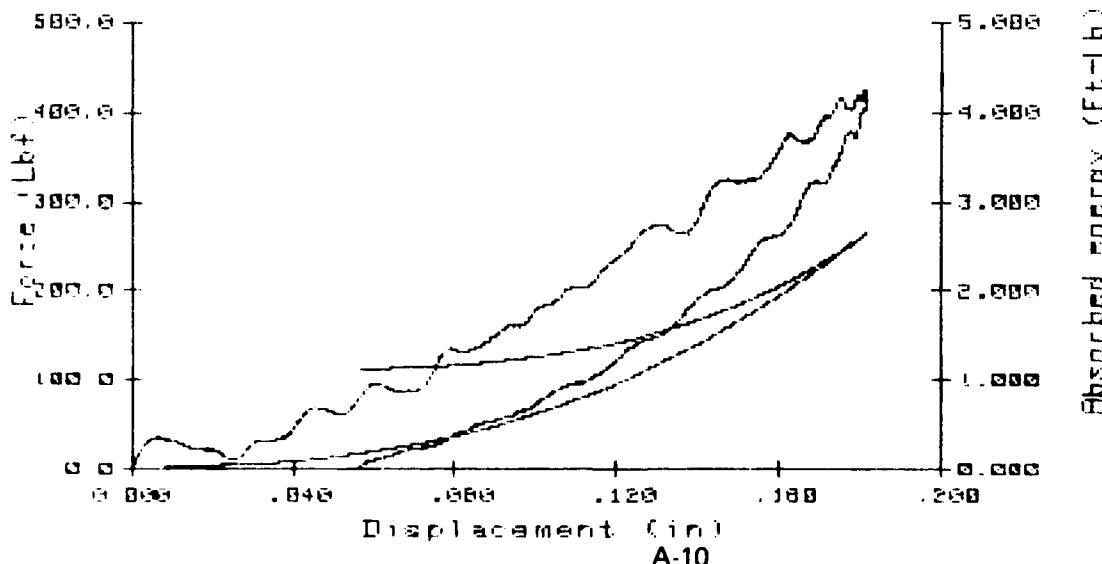
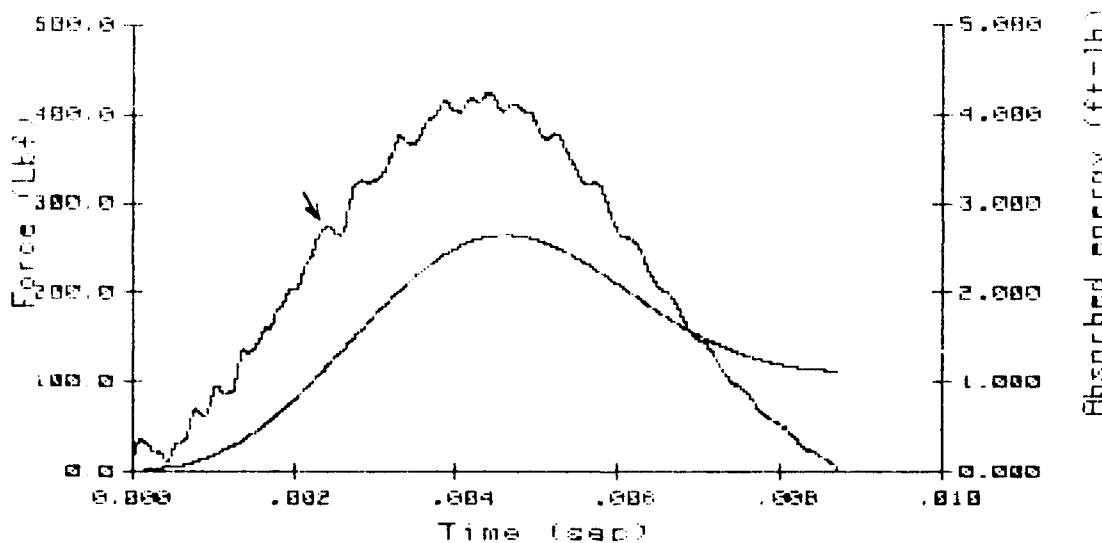


 INSTRUMENTED IMPACT TEST

DRYER 3501-6 #4

Drop weight = 7.00LB Data disk MAT00801
 Tup radius = .500in DRM scale .2kn.Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 4.83ft/s
 K.E. = 2.54ft-Lb V_f (calc) = -3.64ft/s

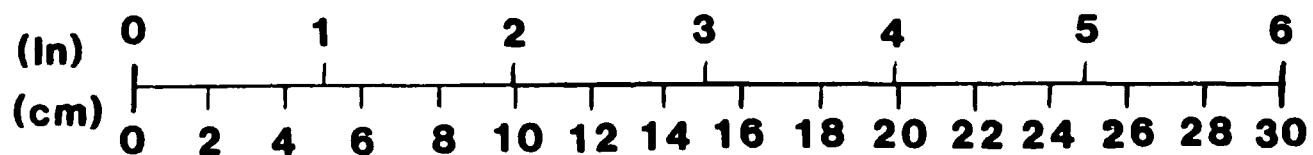
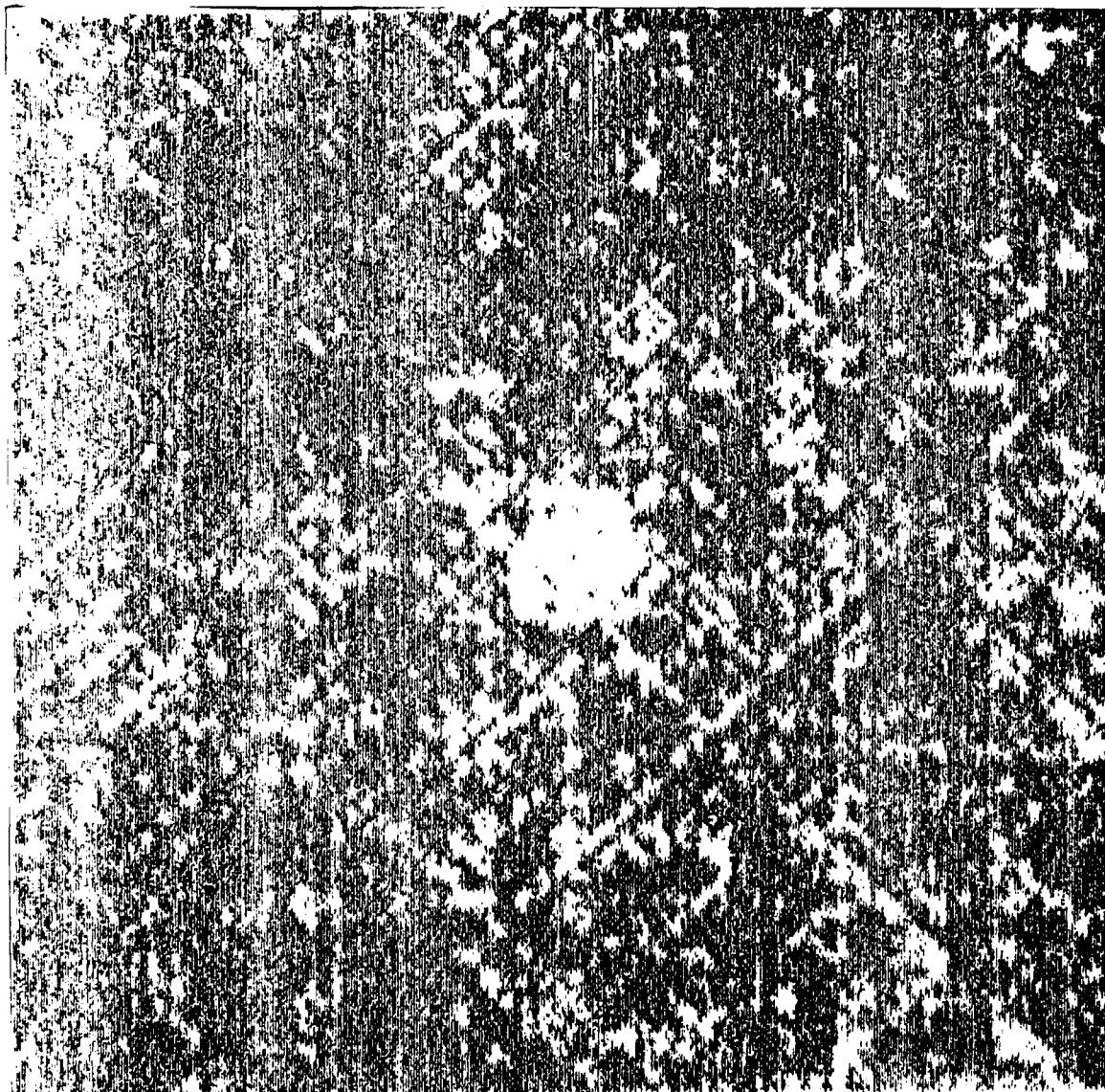
Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
274.7	2.428E-3	1.19	.1308	Initial damage
420.5	4.393E-3	2.62	.1811	Maximum force
403.3	4.613E-3	2.64	.1816	Maximum energy
403.3	4.613E-3	2.64	.1816	Maximum displacement
4.0	8.718E-3	1.13	.0567	Final values



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#4



C-11 EFT-1000 DROP TEST FACILITY

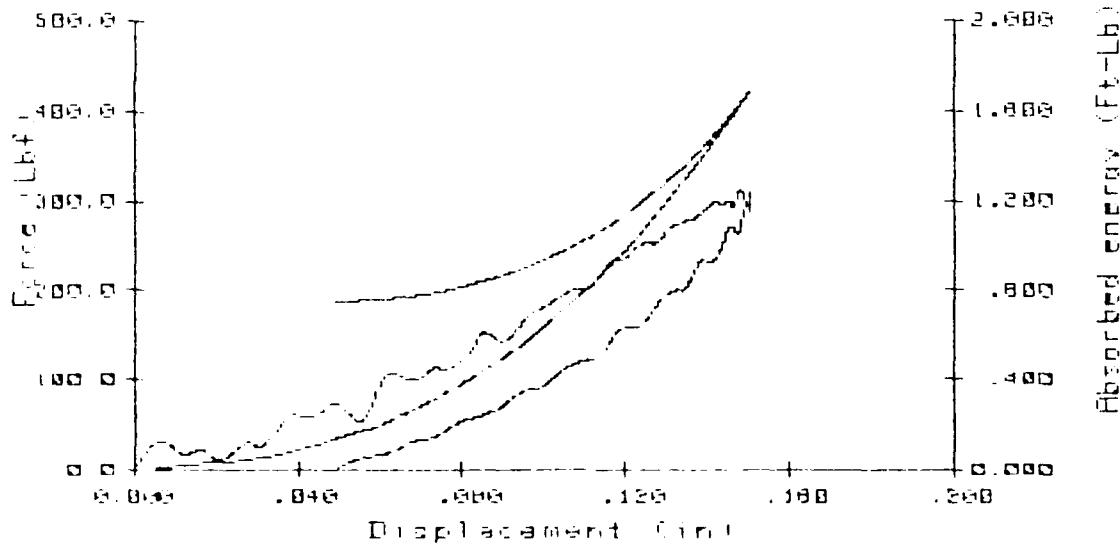
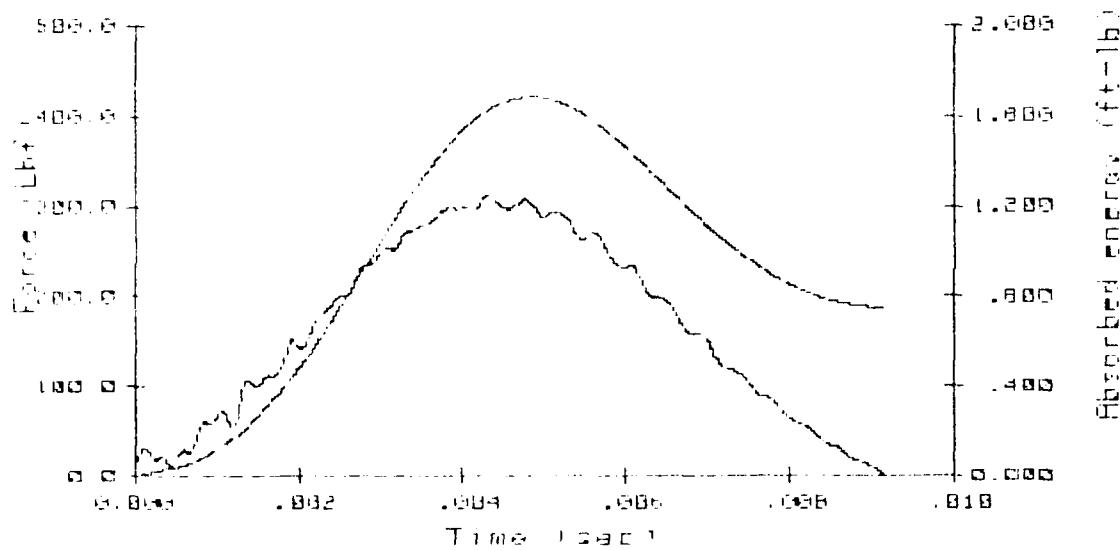
2/27/84

INSTRUMENTED IMPACT TEST

15/1-6 GR/BMI #7

Drop weight =	7.00lb	Delta disk =	MAT00901
Tip radius =	.500in	PKM scale =	.2in/Div
Temperature =	74.0 F	Flag grid =	.040in
Vf =	3.83ft/s	abs(Vf) =	3.44ft/s
F.E.	1.60ft-lb	Vf(calc) =	-2.83ft/s

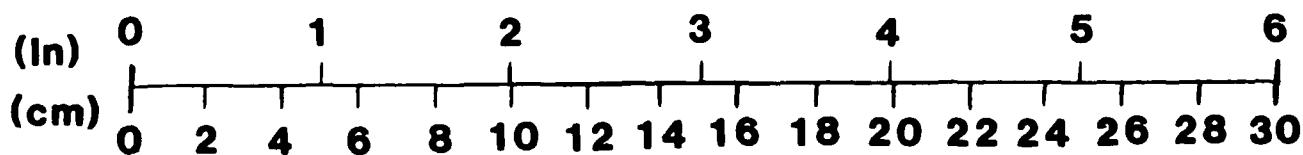
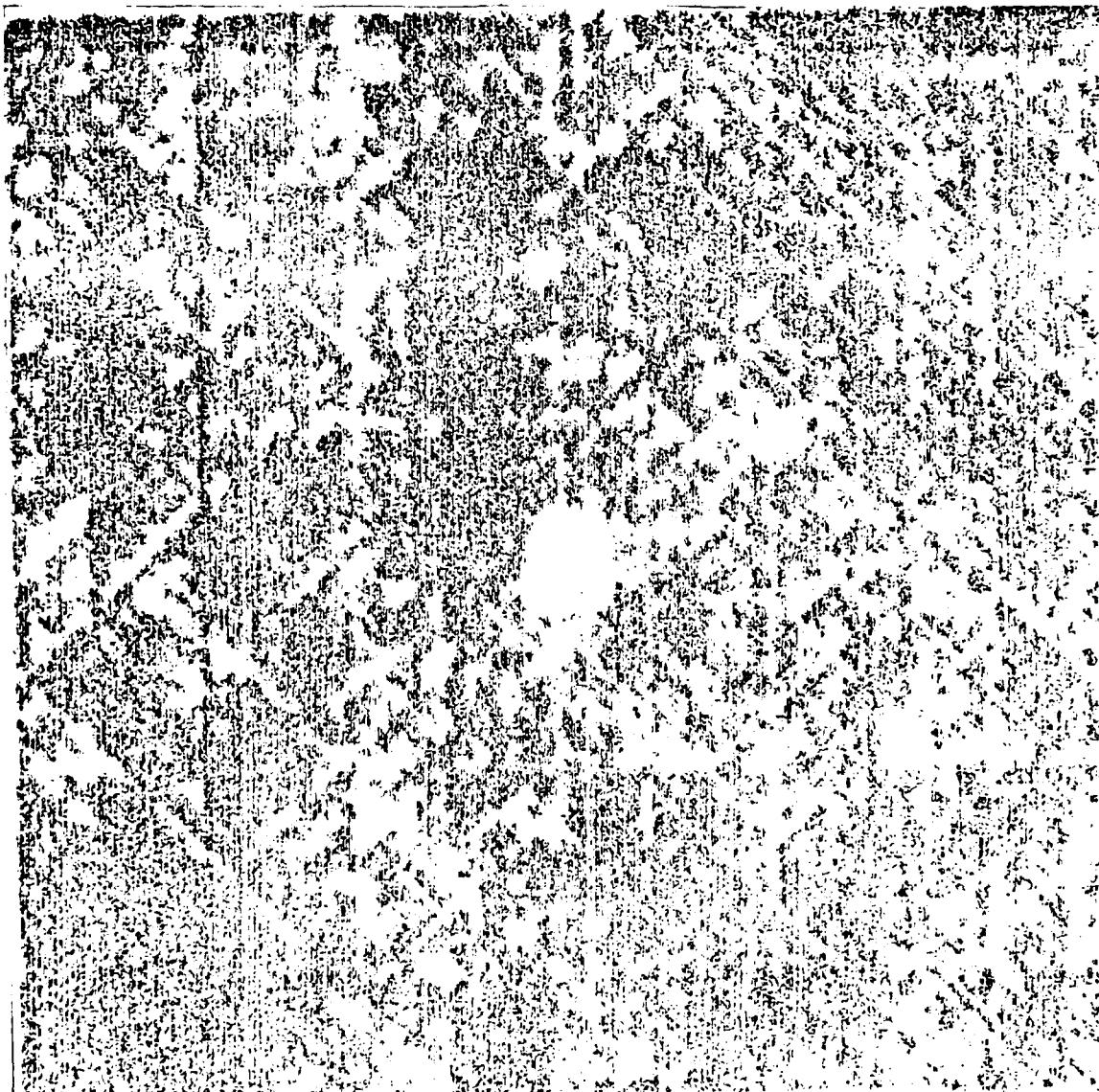
	Load/Lb	Time/s	EI(Ft-lb)	Disp/in	
717.5	4.375E-7	1.62	.1480	Maximum force	
300.0	4.845E-7	1.68	.1503	Maximum energy	
300.0	4.845E-7	1.68	.1503	Maximum displacement	
1.4	9.145E-7	.75	.0493	Final values	



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#7



NADC-85023-60

AFTI E11-B2000 DEDF TEST FACILITY

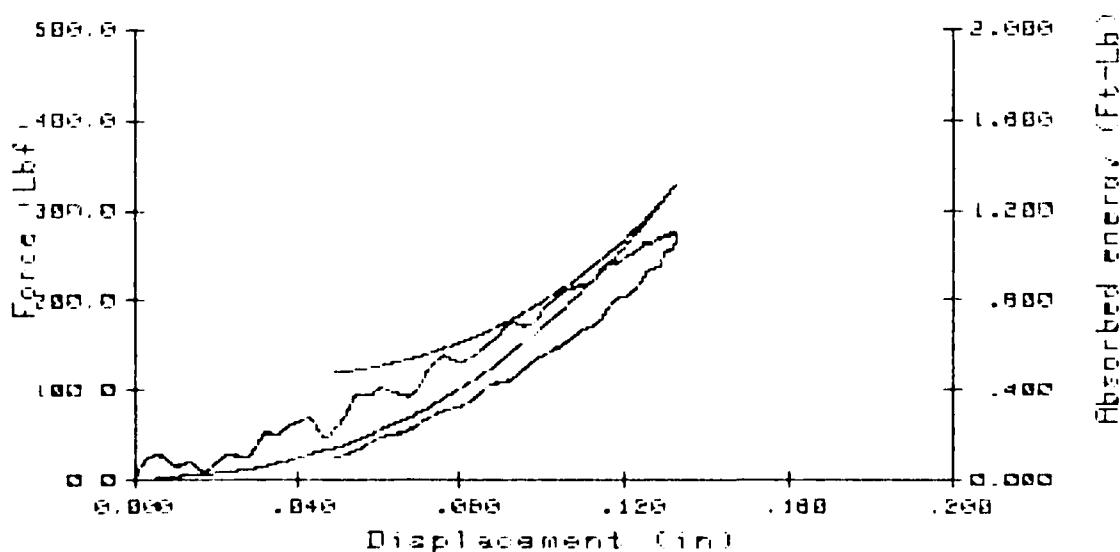
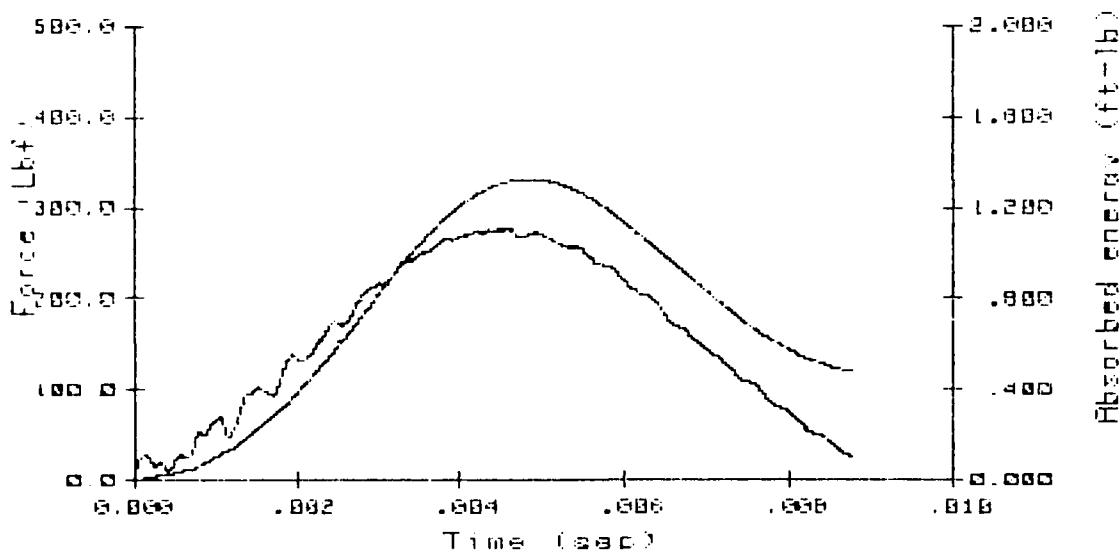
15-0-

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INSTRUMENTED IMPACT TEST
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AS4/3501-6 #8

Drop weight =	7.00Lb	Data disk =	MAT01002
Tup radius =	.500in	DRM scale =	.2Kg/Div
Temperature =	74.0 F	Flag grid =	.040in
V0 =	3.38ft/s		
F.E. =	1.24ft-Lb	Vf(calc) =	-2.71ft/s

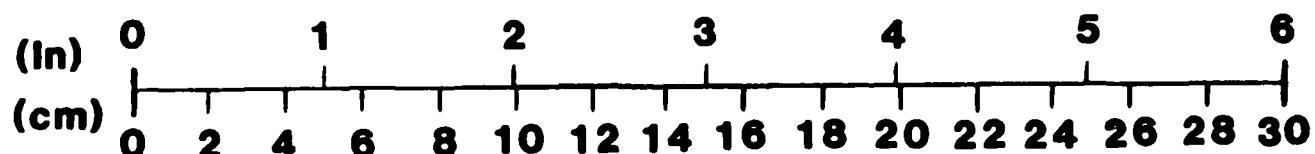
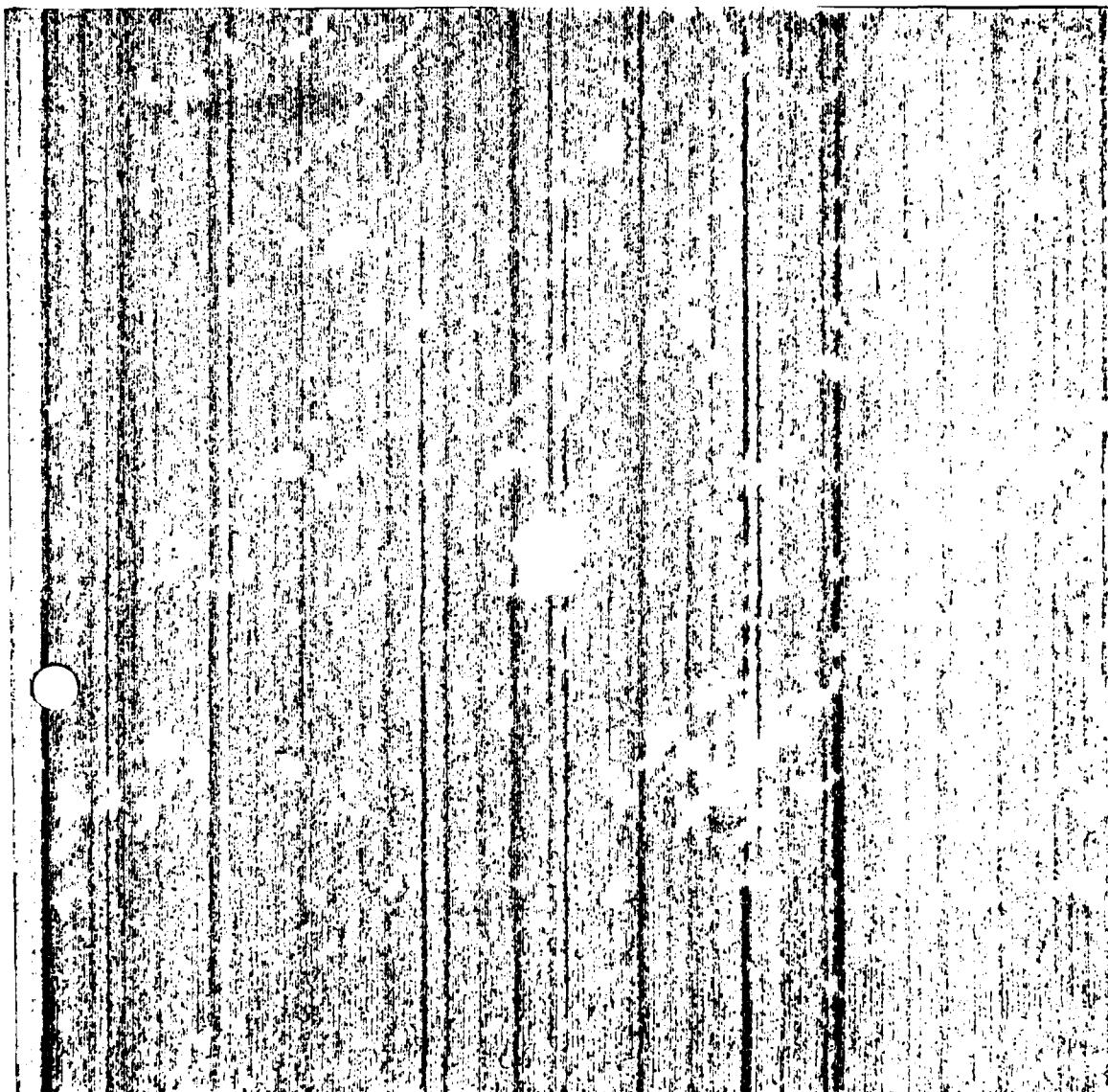
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
277.4	4.617E-3	1.31	.1324	Maximum force
269.3	4.843E-3	1.32	.1327	Maximum energy
269.3	4.843E-3	1.32	.1327	Maximum displacement
25.6	8.792E-3	.48	.0492	Final values



NADC-85023-60

GR/EP 3501-6

#8



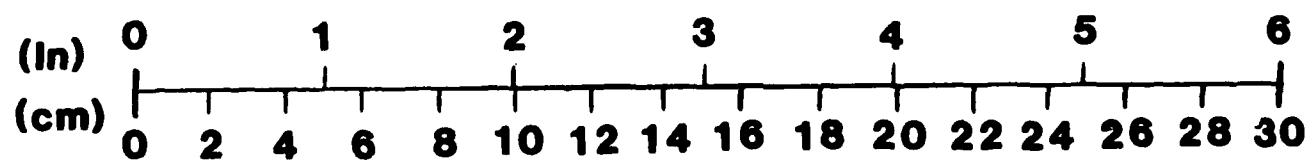
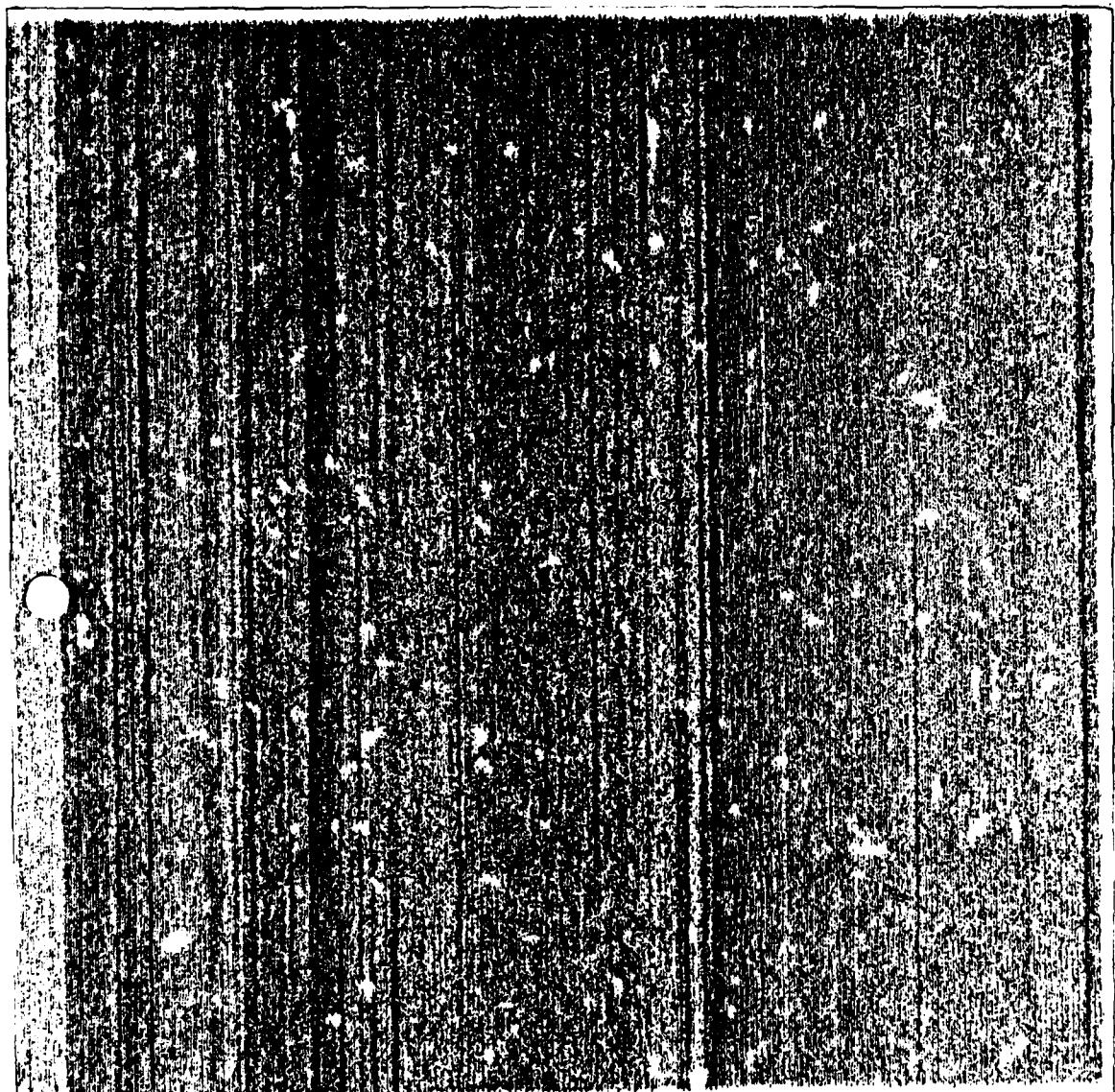
NADC-85023-60

AS4/2220-1

NADC-85023-60

2220-1 GR/EP

#8



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

1/4/84

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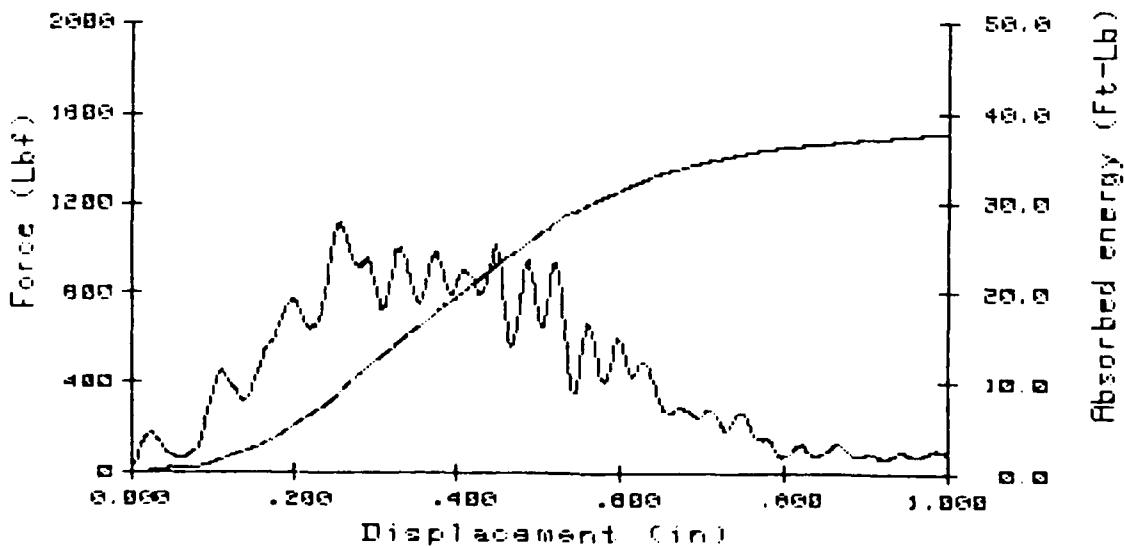
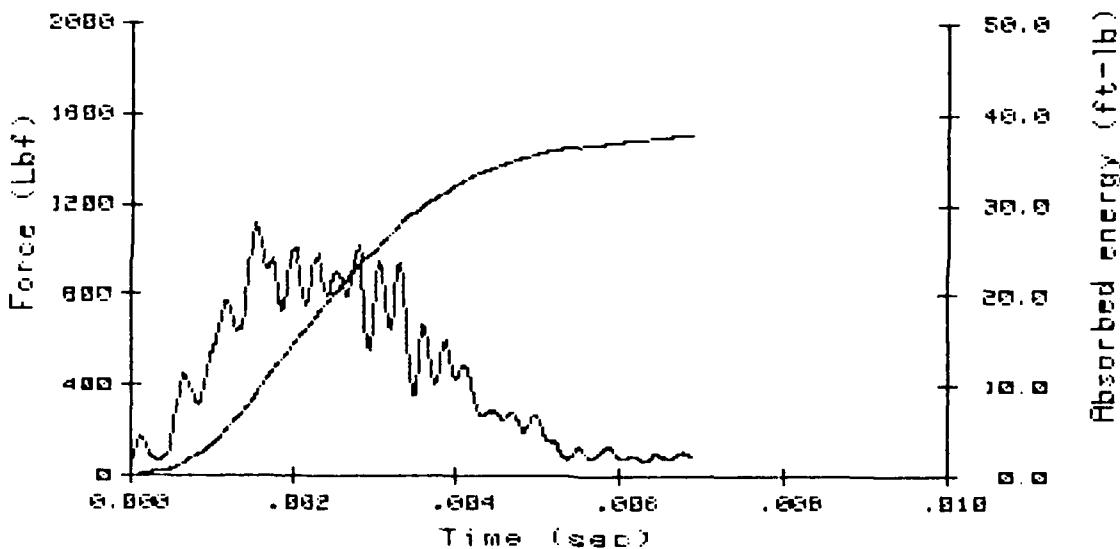
INSTRUMENTED IMPACT TEST

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2220-1 GR/EP #1

Drop weight	= 31.36Lb	Data disk	MAT00601
Tup radius	= .500in	DRM scale	.8Kn/Div
Temperature	= 74.0 F	Flag grid=	.040in
V ₀	= 13.89ft/s		
K.E.	= 93.93ft-Lb	V _f (calc) =	10.98ft/s

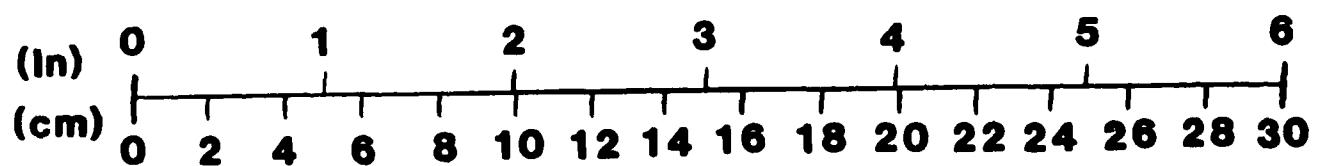
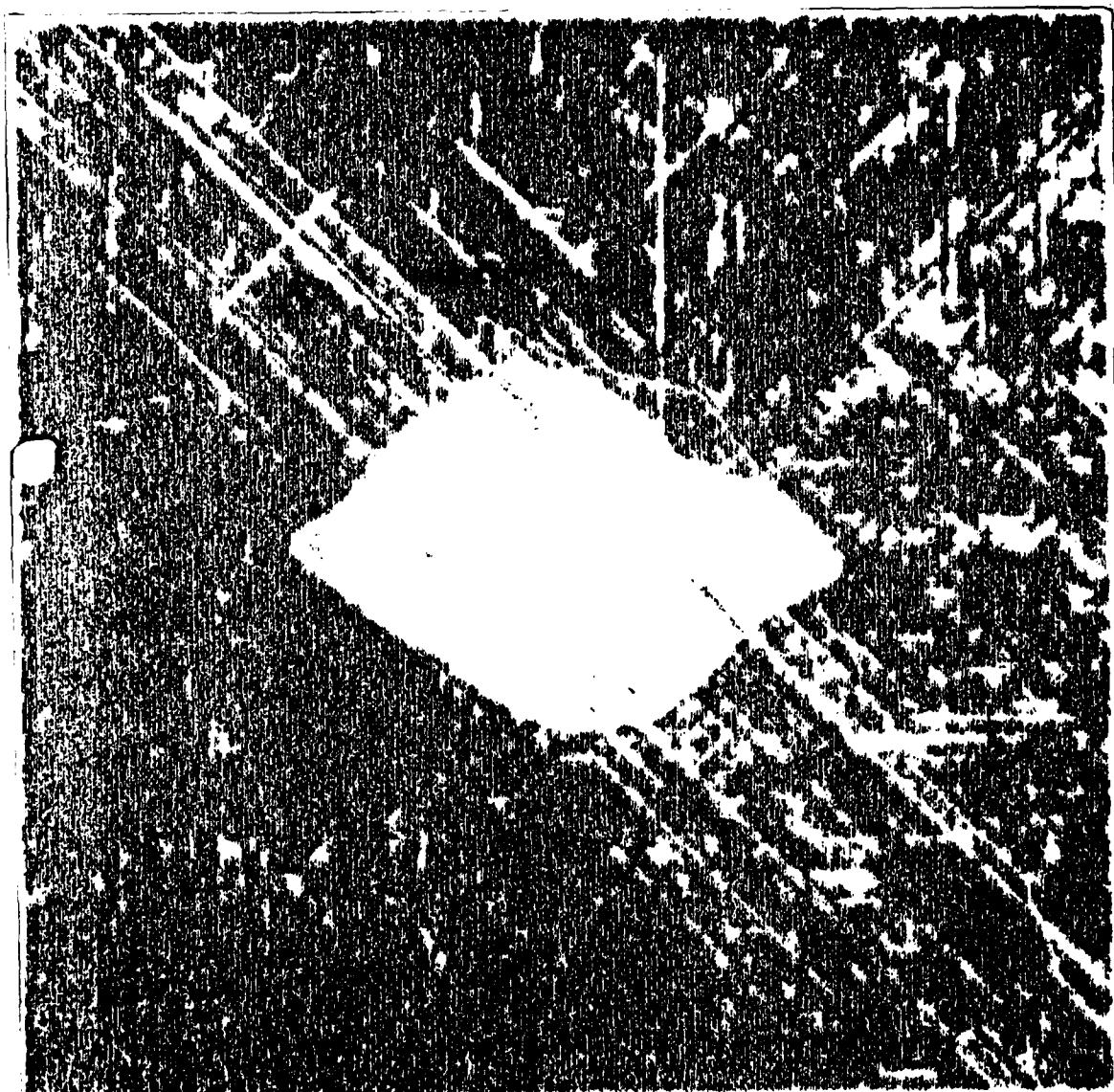
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
1115.1	1.545E-3	8.97	.2565	Maximum force
89.9	6.865E-3	37.79	.9989	Maximum energy
89.9	6.865E-3	37.79	.9989	Maximum displacement
89.9	6.865E-3	37.79	.9989	Final values



NADC-85023-60

2220-1 GR/EP

#1

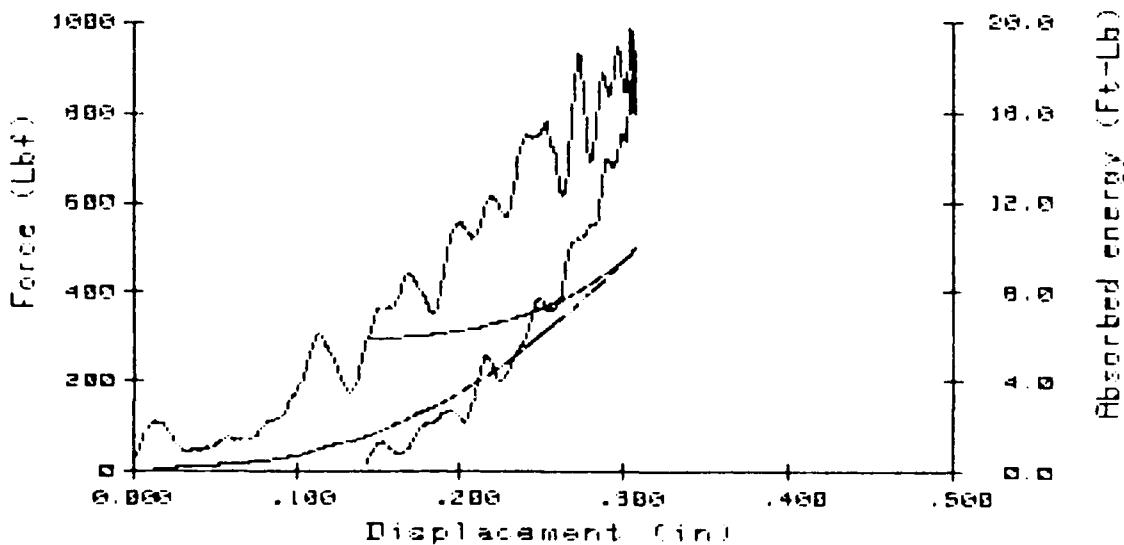
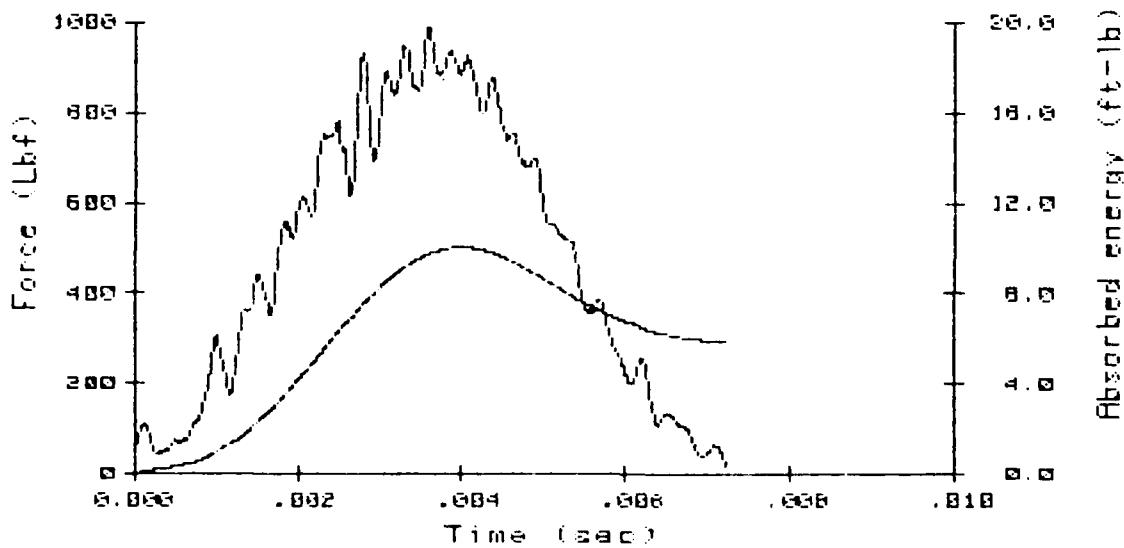


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INSTRUMENTED IMPACT TEST
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2220-1 GR/EP #2

Drop weight = 7.00LB Data disk MAT00602
 Tup radius = .500in DRM scale .8Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 $V_0 = 9.52 \text{ ft/s}$ abs(V_f) = 7.75ft/s
 K.E. = 9.86ft-Lb $V_f(\text{calc})$ = -6.10ft/s

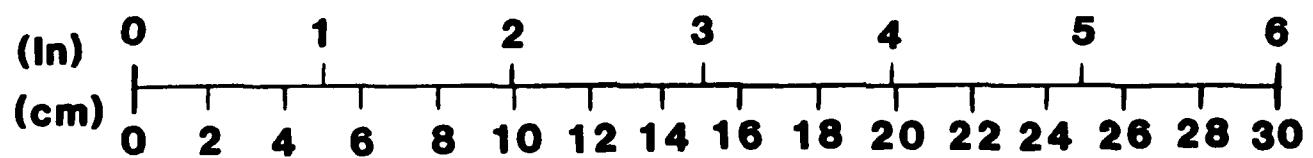
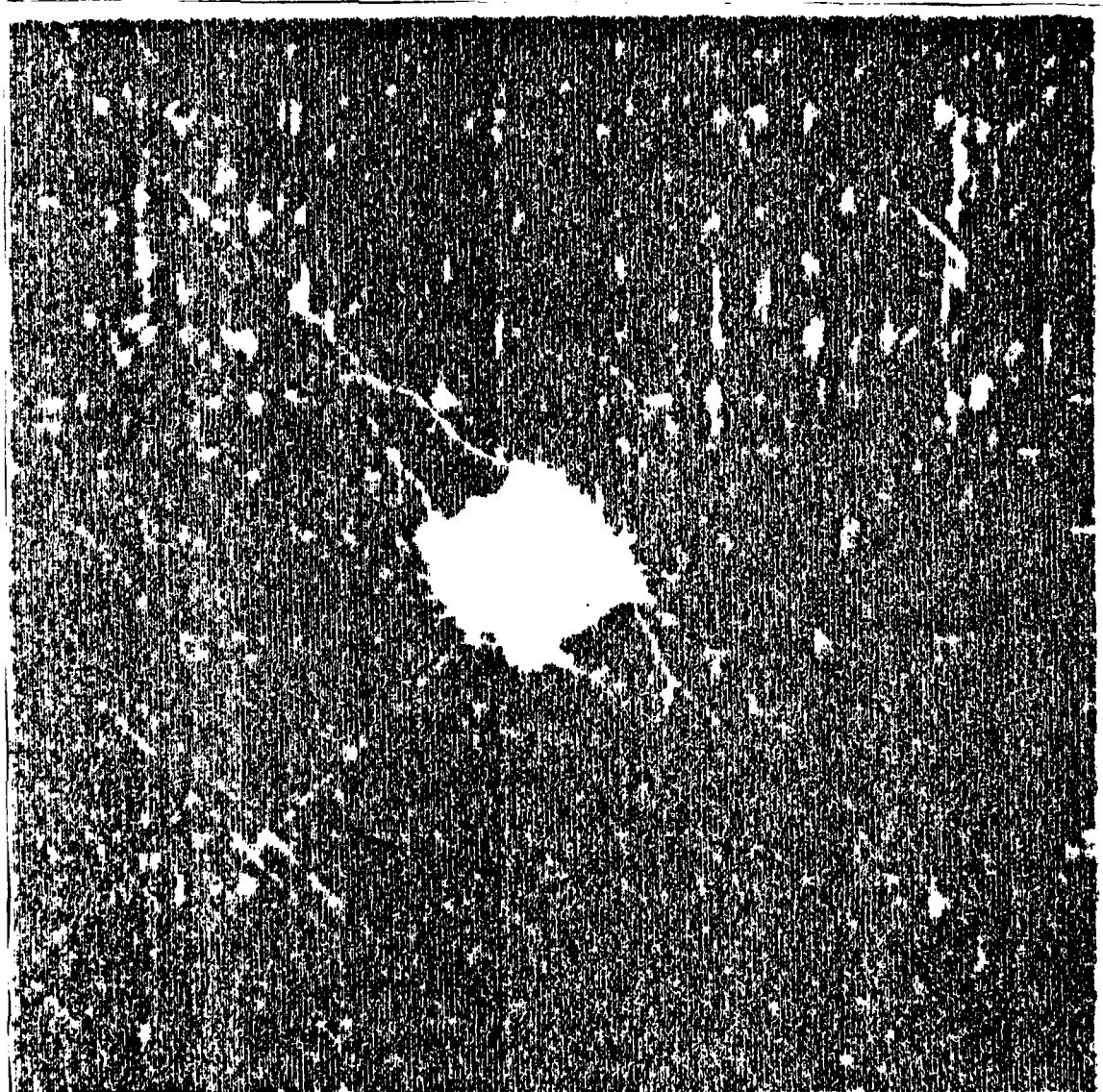
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
989.2	3.595E-3	9.74	.3039	Maximum force
888.4	3.995E-3	10.04	.3078	Maximum energy
888.4	3.995E-3	10.04	.3078	Maximum displacement
16.2	7.225E-3	5.90	.1426	Final values



NADC-85023-60

2220-1 GR/EP

#2



NADC-85023-60

NADC/ETI-B200 DROP TEST FACILITY

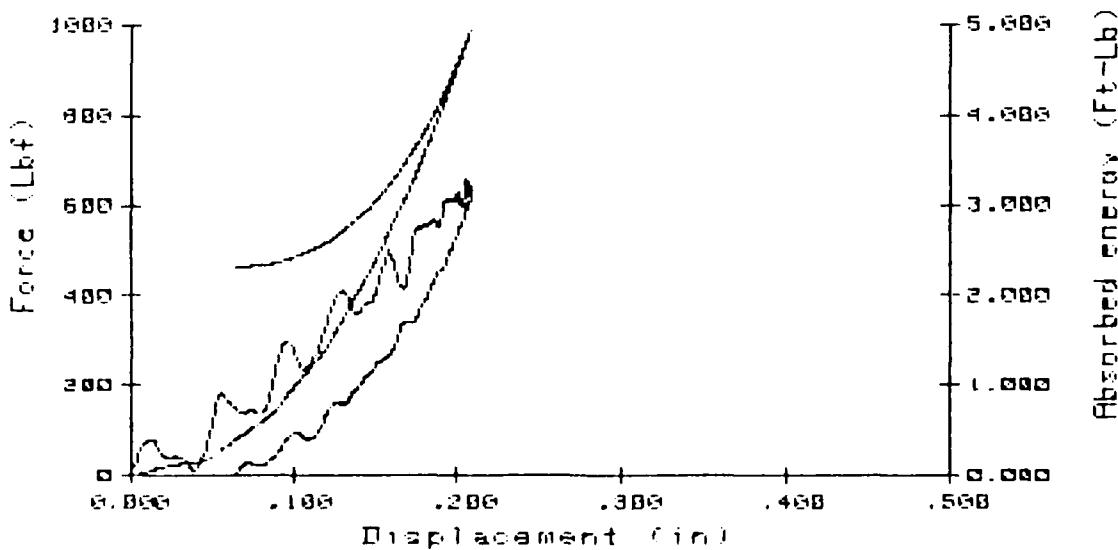
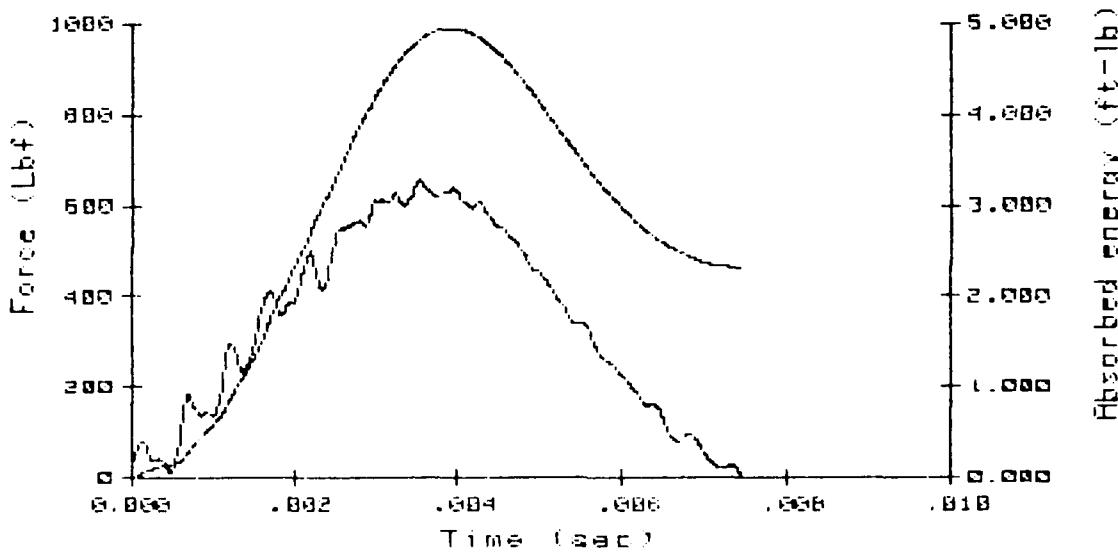
1/4/84

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INSTRUMENTED IMPACT TEST
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2220-1 GR/EP #3

Drop weight = 7.00lb Data disk MAT00603
 Tup radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 VO = 6.67ft/s abs(Vf) = 5.95ft/s
 K.E. = 4.83ft-Lb Vf(calc) = -4.85ft/s

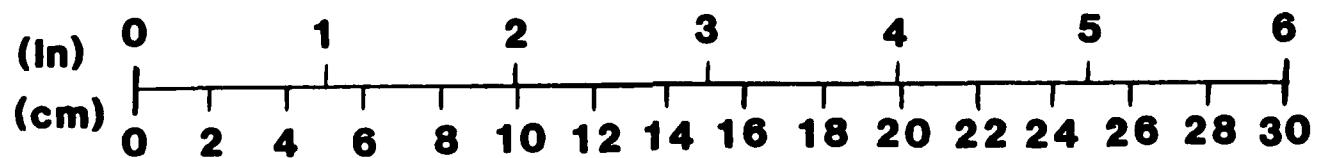
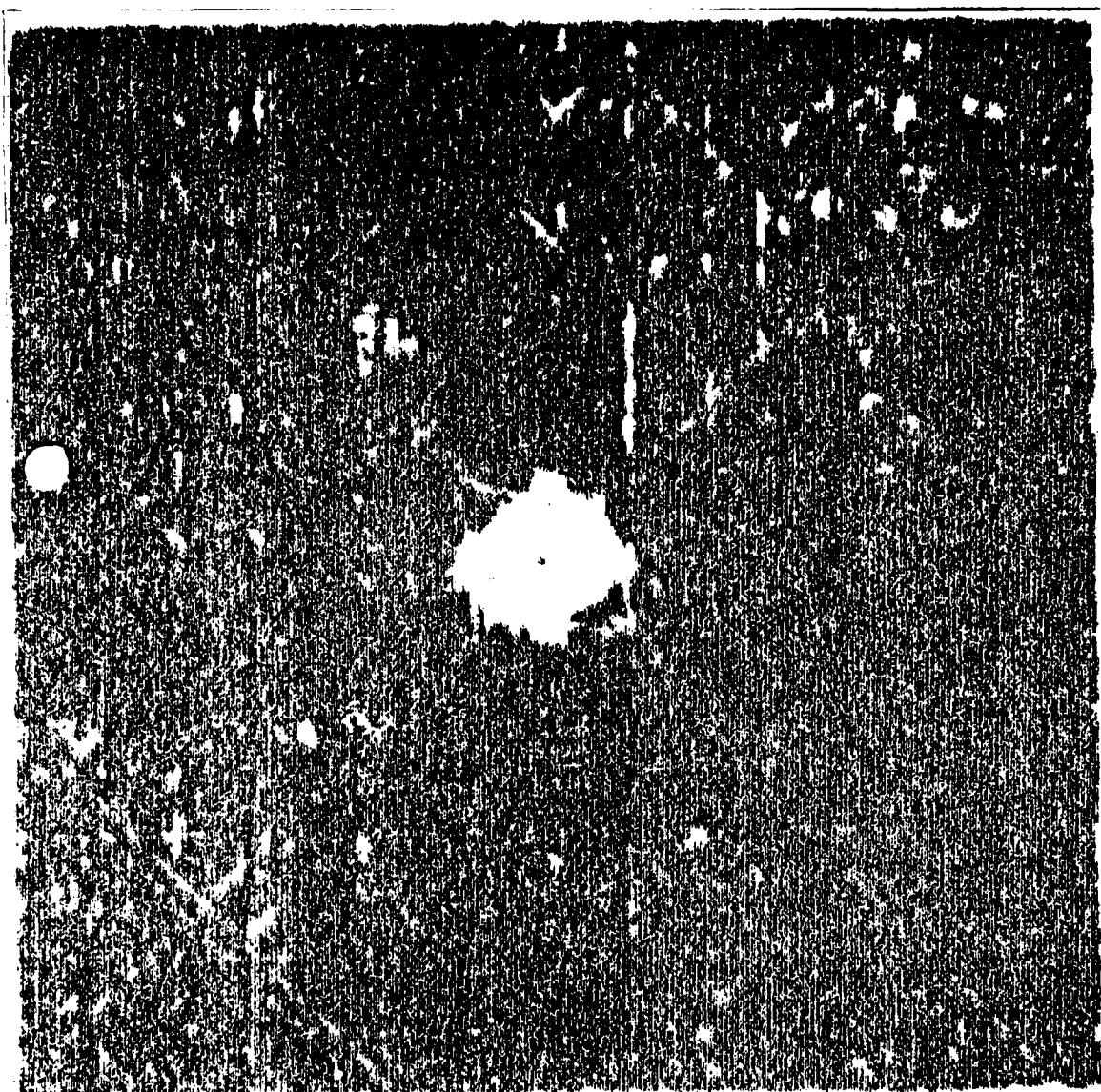
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
658.2	3.525E-3	4.81	.2055	Maximum force
634.0	3.915E-3	4.95	.2081	Maximum energy
634.0	3.915E-3	4.95	.2081	Maximum displacement
7.2	7.435E-3	2.32	.0663	Final values



NADC-85023-60

2220-1 GR/EP

#3



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NADC/ETI-B200 DROP TEST FACILITY

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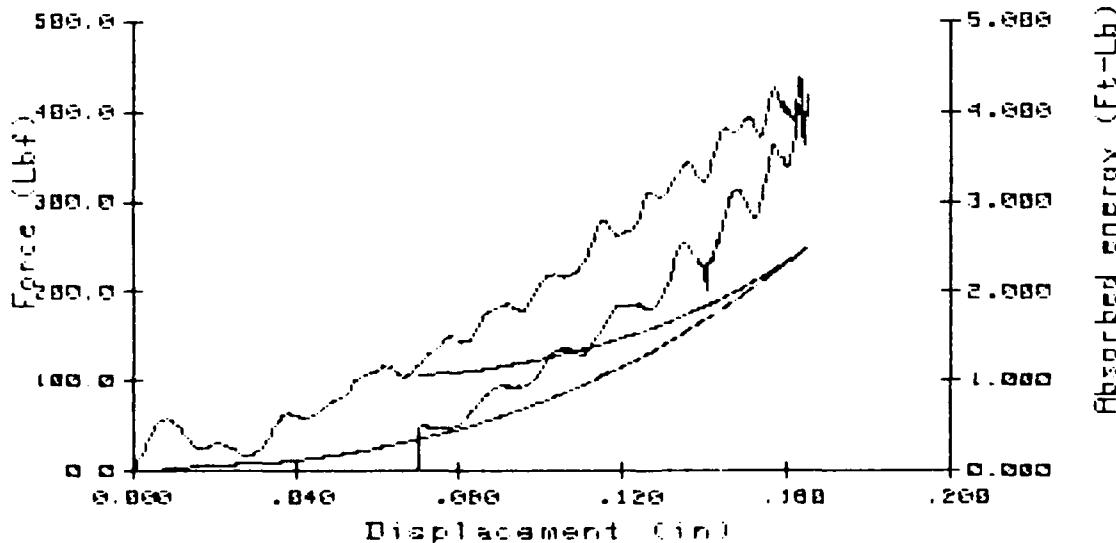
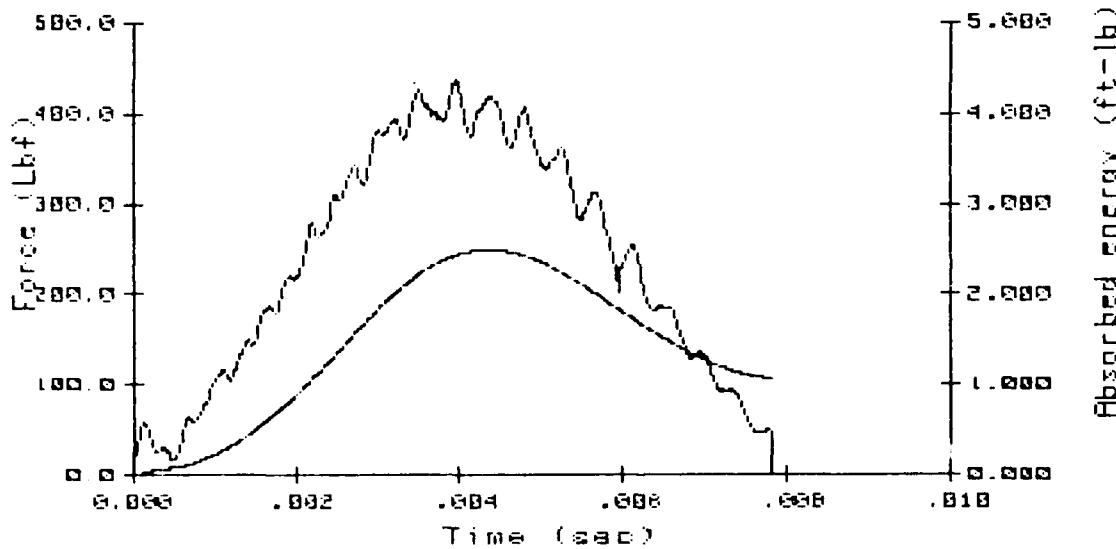
=====
INSTRUMENTED IMPACT TEST
=====

4

2220-1 GR/EF #X

Drop weight = 7.00LB Data disk MAT00604
 Tup radius = .500in DRM scale .2Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 4.69ft/s abs(V_f) = 4.27ft/s
 K.E. = 2.40ft-Lb V_f (calc) = -3.54ft/s

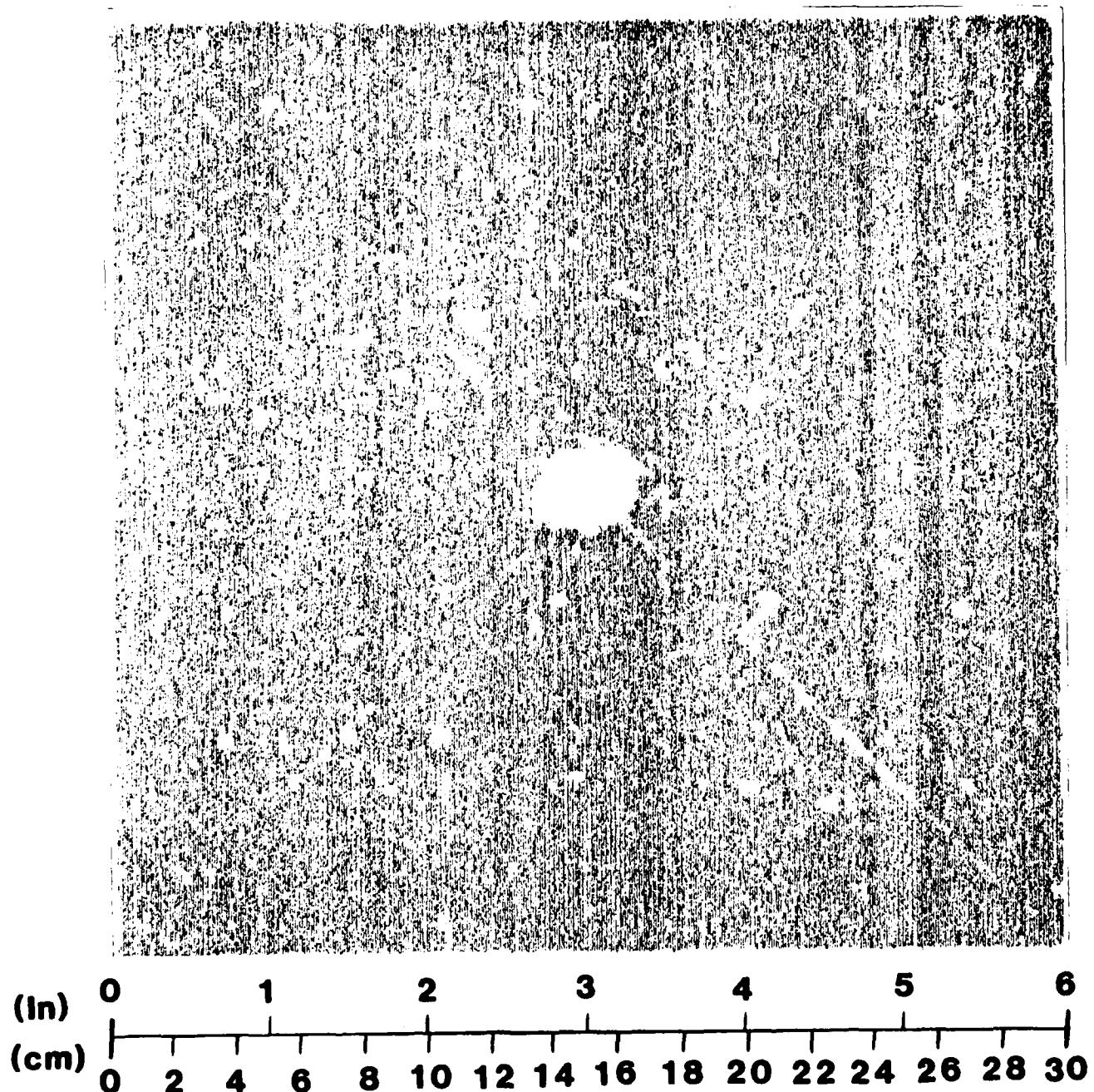
Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
438.4	3.45E-3	2.43	.1632	Maximum force
417.7	4.355E-3	2.49	.1651	Maximum energy
417.7	4.355E-3	2.49	.1651	Maximum displacement
-218.5	7.805E-3	1.07	.0699	Final values



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2220-1 GR/EP

#4



NADC-85023-60

TEST E71-82001 DROP TEST FACILITY

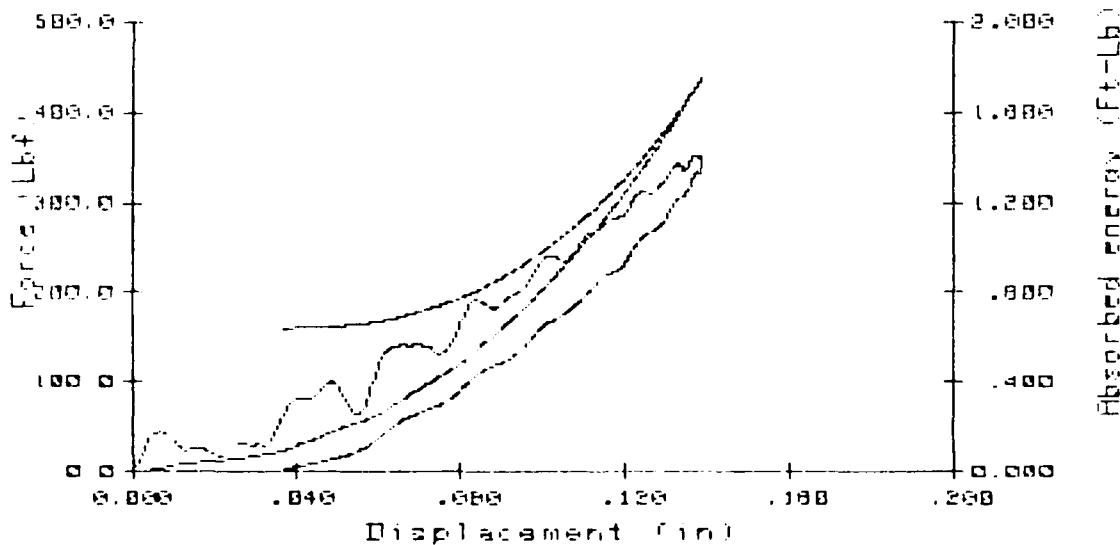
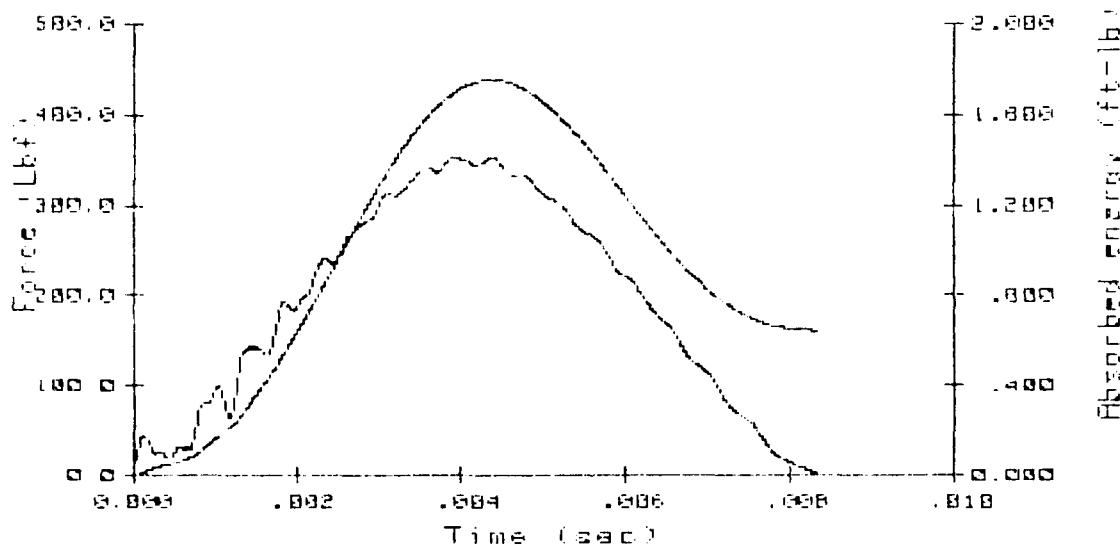
TEST E71-82001

INSTRUMENTED IMPACT TEST

TEST-1 GR/EP #6

Drop weight =	7.00lb	Data dist =	MAT00807
Tup radius =	.500in	DRM scale =	.2in/Div
Temperature =	74.0 F	Flag grid =	.040in
V_0 =	3.92ft/s	abs(Vf) =	3.75ft/s
I.E. =	1.67ft-lb	Vf (calc) =	-3.11ft/s

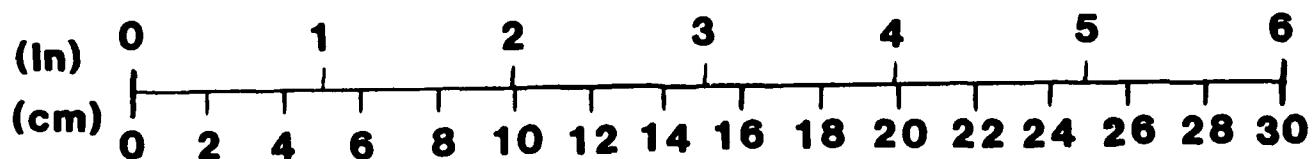
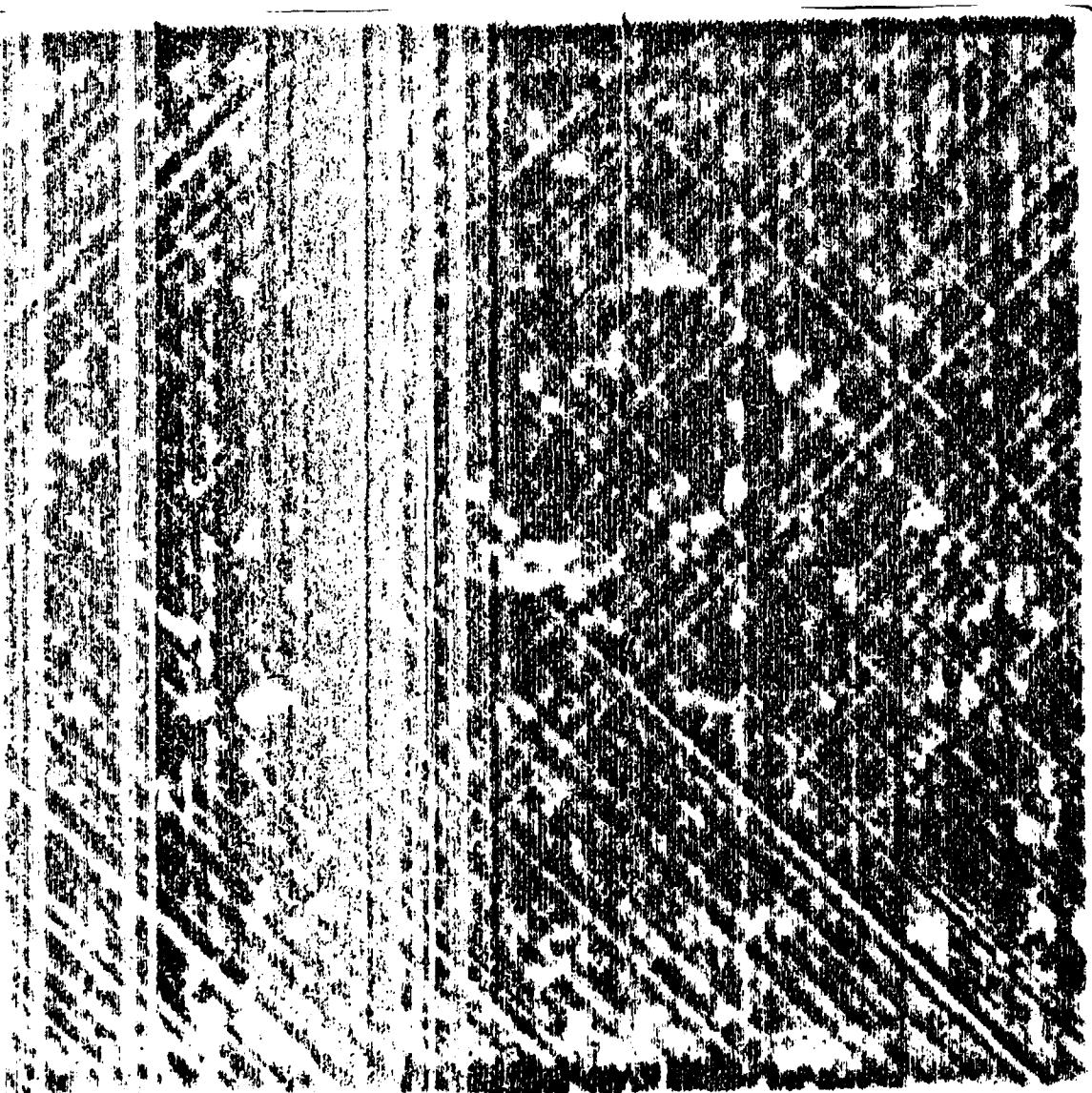
Load (lb)	Time (s)	E0 (Ft-lb)	Disp (in)	
351.2	4.375E-3	1.75	.1387	All maximum
1.6	8.325E-3	.64	.0370	Final values



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2220-1 GR/EP

#6



NADC-85023-60

DOD DIA-AIR FORCE TEST FACILITY

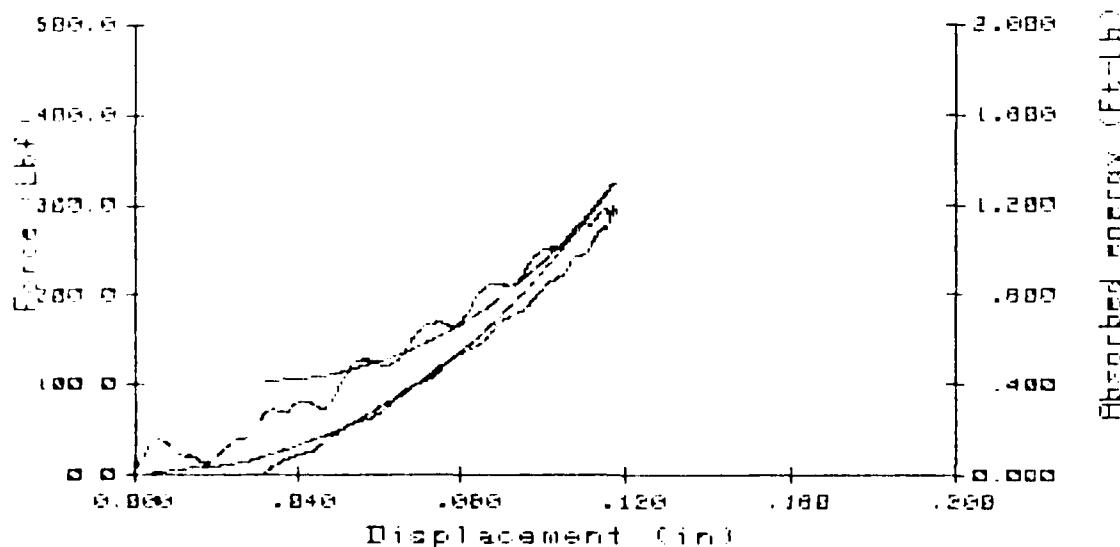
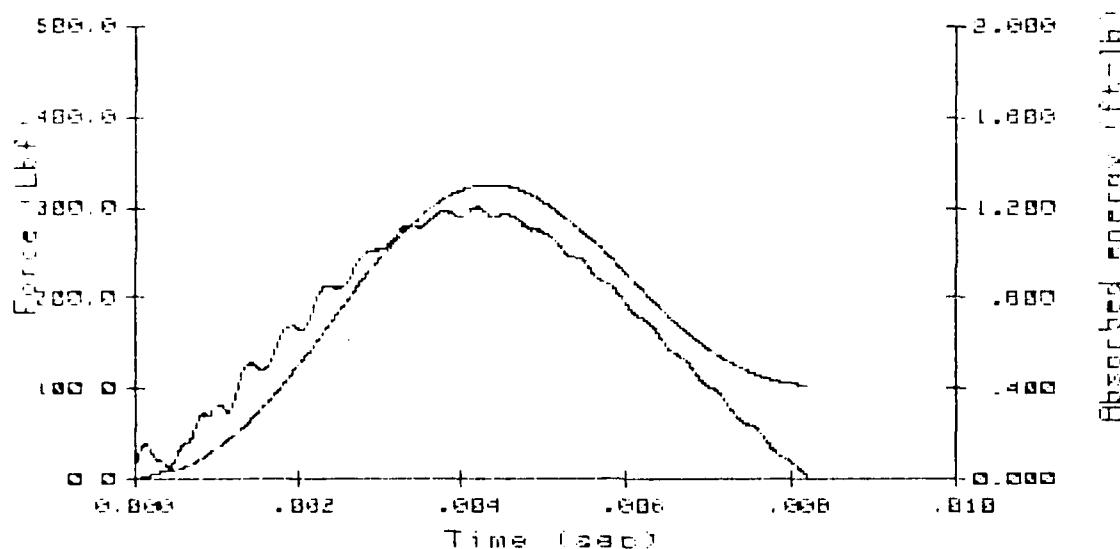
7/15/84

INSTRUMENTED IMPACT TEST

2220-1 GR/EP #7

Drop weight = 7.00LB Data disk MAT01.DAT
 Tip radius = .500in DRM scale .2in/Div
 Temperature = 74.0 F Flag grid = .040in
 V_0 = 3.37ft/s abs(V_f) = 3.24ft/s
 F.E. = 1.23ft-Lb V_f (calc) = -2.77ft/s

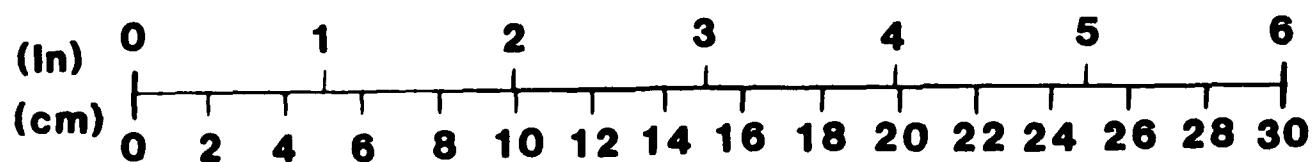
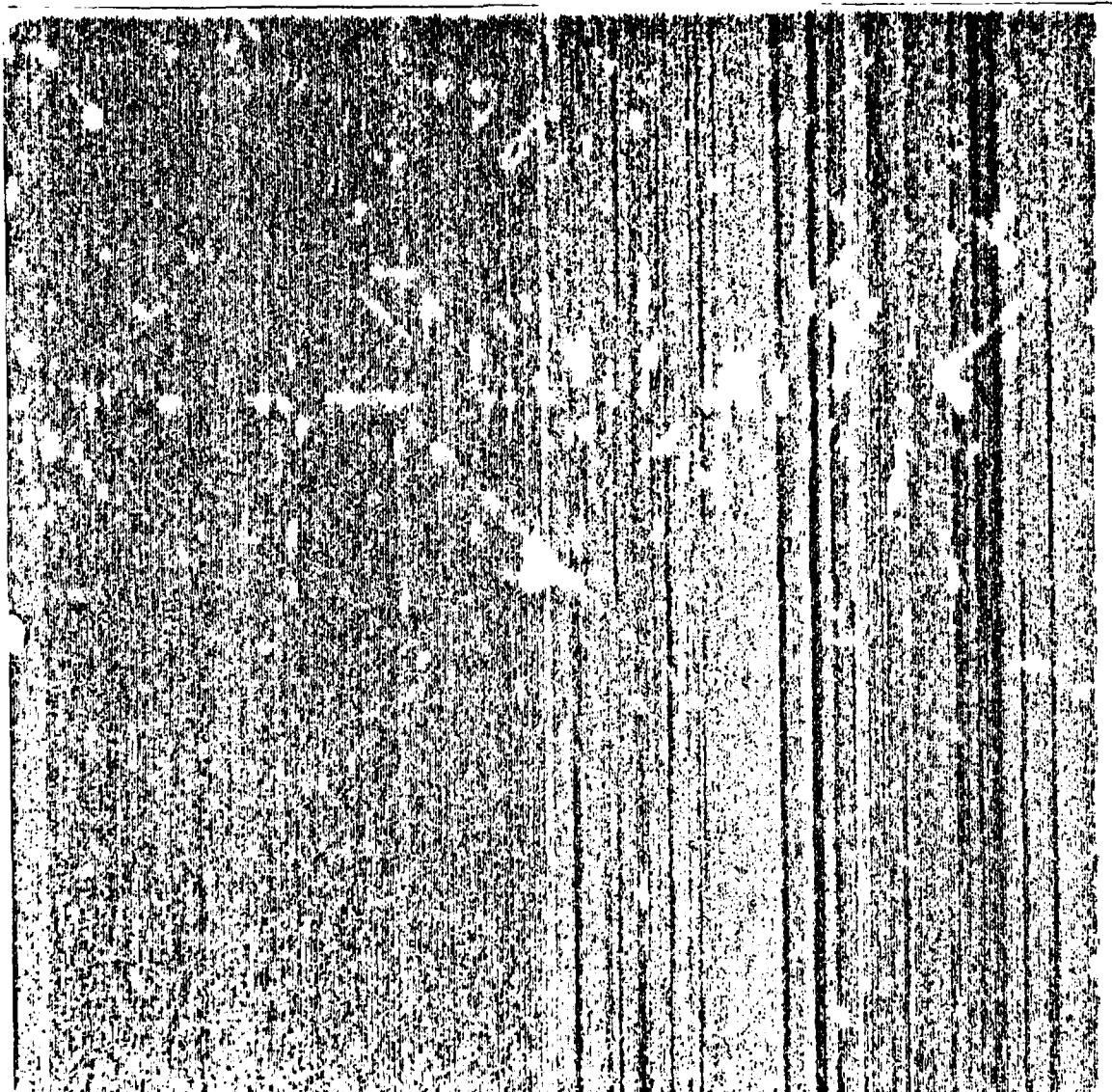
Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
301.2	4.195E-3	1.30	.1171	Maximum force
291.8	4.345E-3	1.30	.1172	Maximum energy
291.8	4.345E-3	1.30	.1172	Maximum displacement
3.6	8.188E-3	.42	.0321	Final values



NADC-85023-60

2220-1 GR/EP

#7



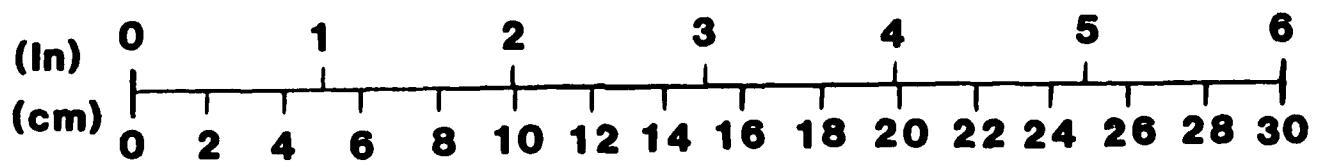
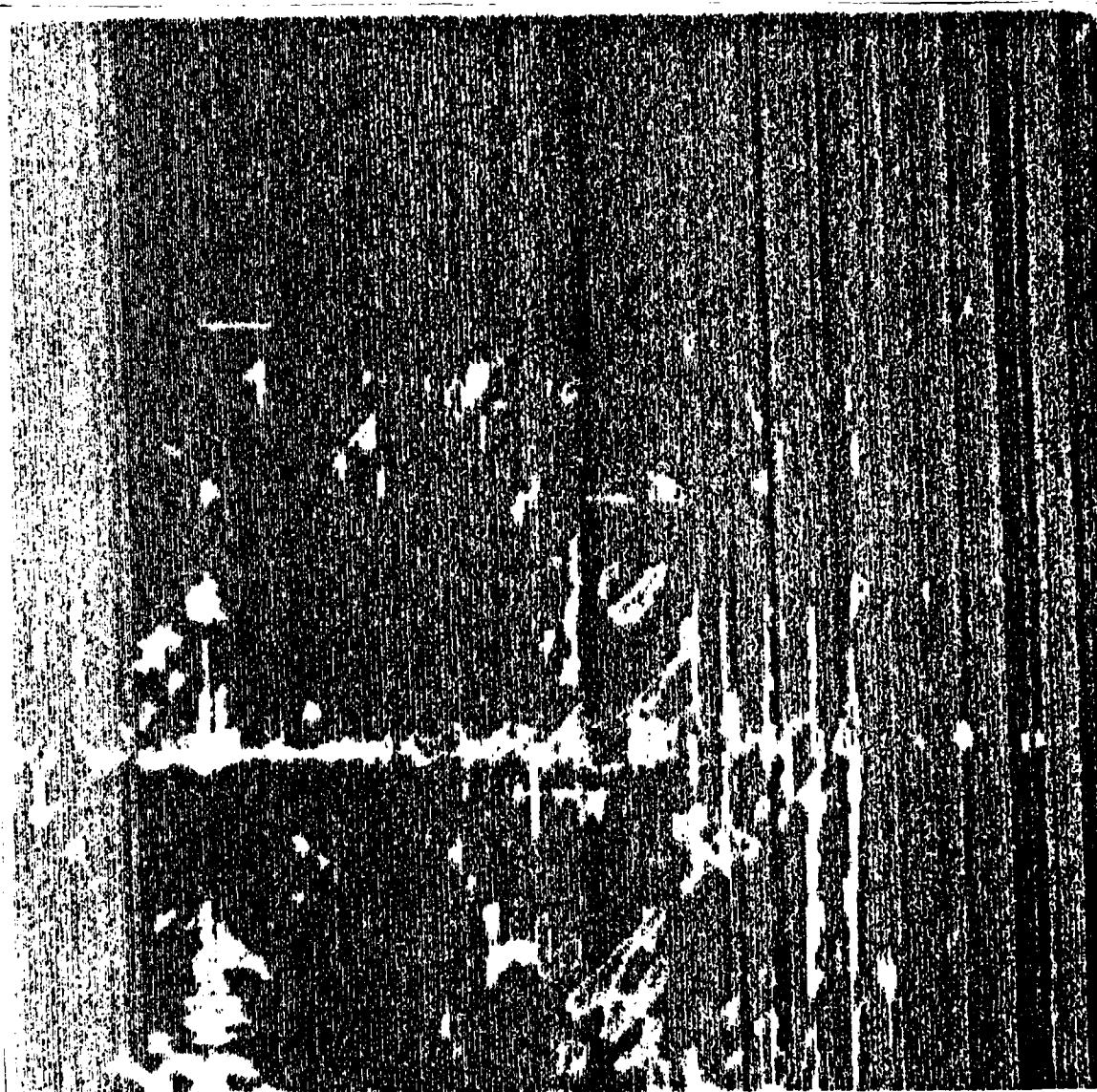
NADC-85023-60

Celion high strain/5245

NADC-85023-60

5245 GR/BMI

#10



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

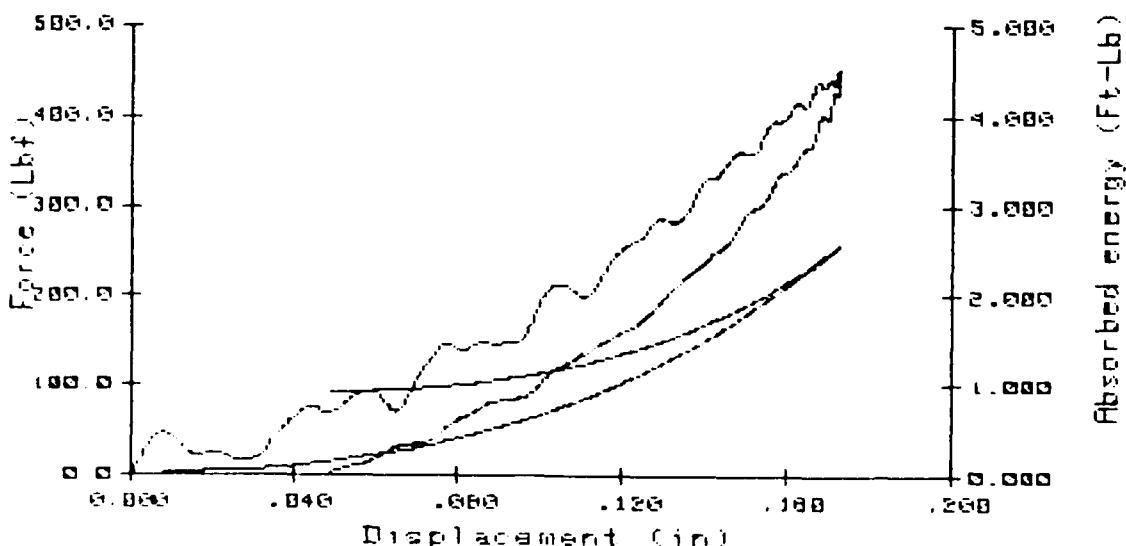
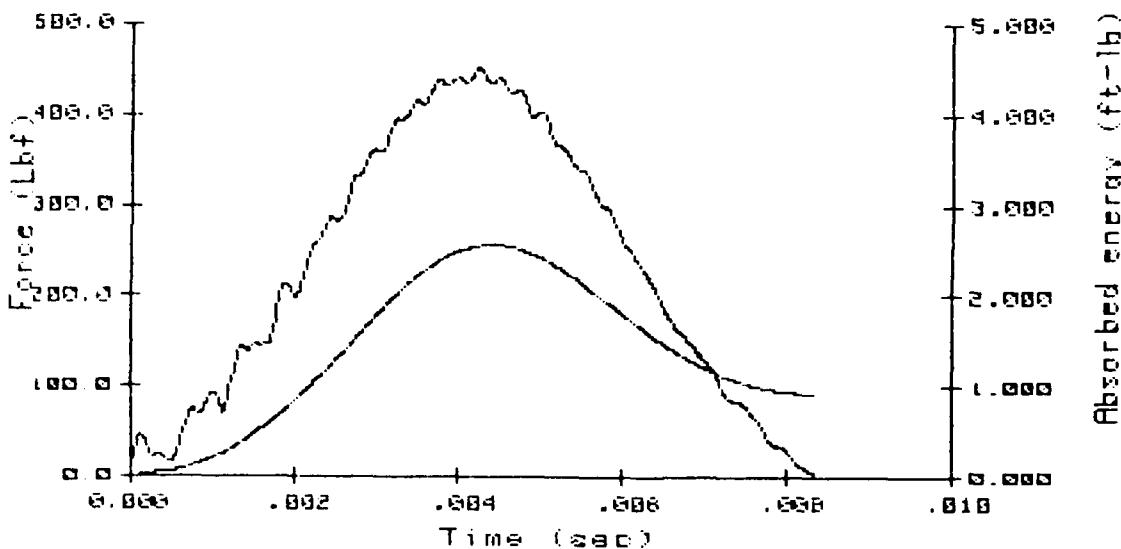
1/4/84

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INSTRUMENTED IMPACT TEST
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5245 GR/BMI #1

Drop weight = 7.00Lb Data disk MAT00605
Tup radius = .500in DRM scale .2Kn/Div
Temperature = 74.0 F Flag grid= .040in
 V_0 = 4.76ft/s abs(V_f) = 4.50ft/s
K.E. = 2.46ft-Lb V_f (calc) = -3.79ft/s

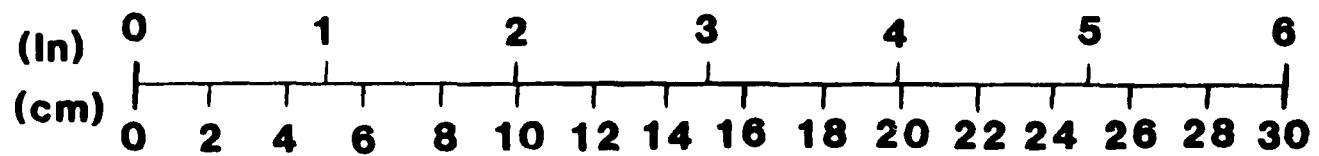
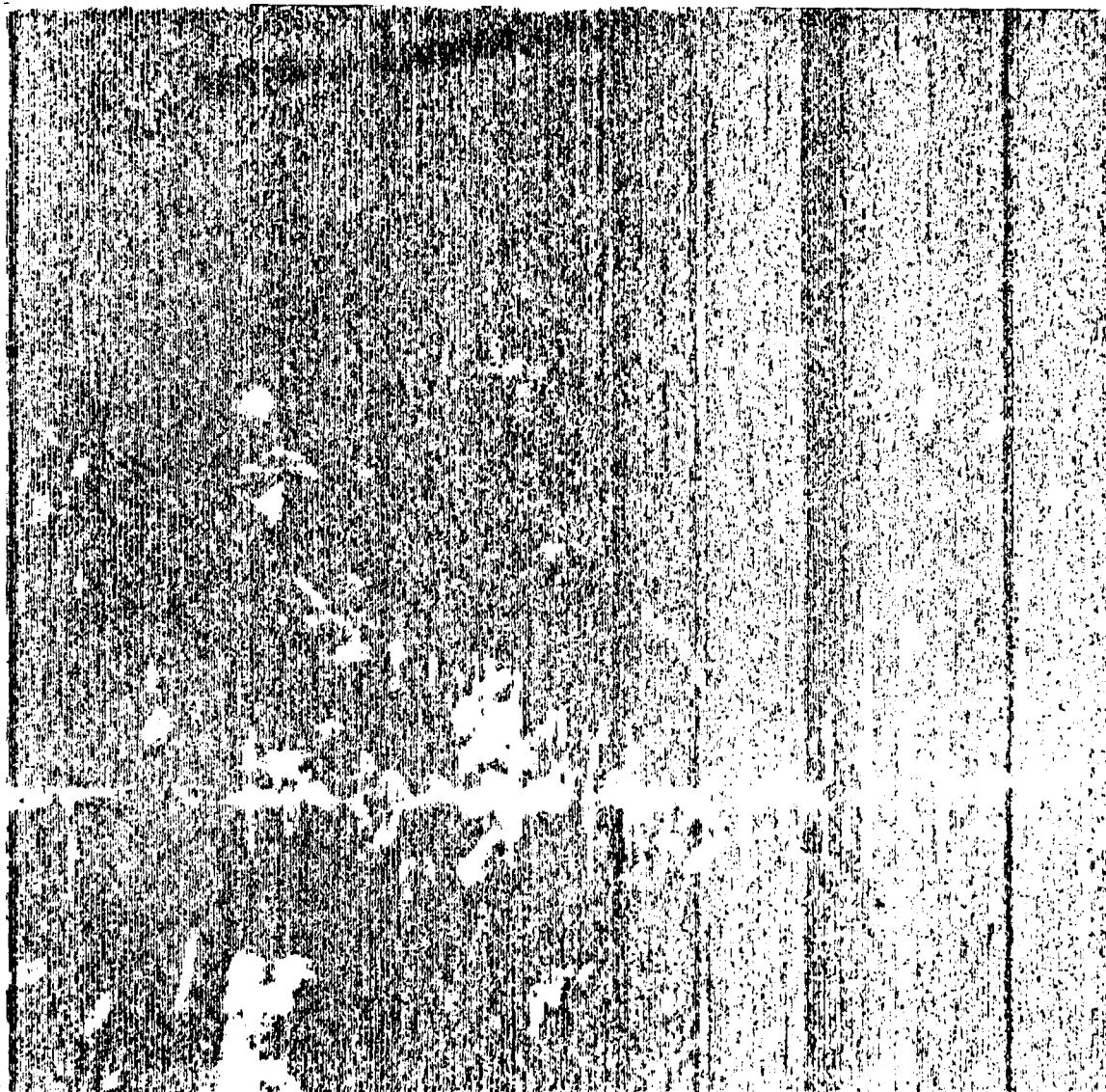
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
451.0	4.225E-3	2.55	.1723	Maximum force
435.2	4.405E-3	2.57	.1727	Maximum energy
435.2	4.405E-3	2.57	.1727	Maximum displacement
3.6	8.325E-3	.93	.0494	Final values



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5245 GR/BMI

#1



NADC-85023-60

NADC/ETI-B200 DROP TEST FACILITY

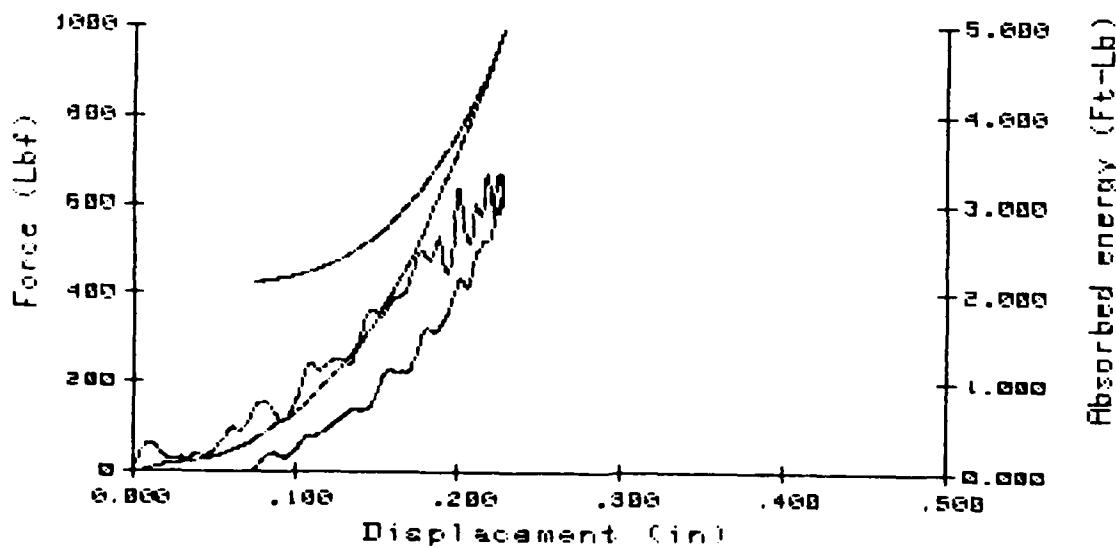
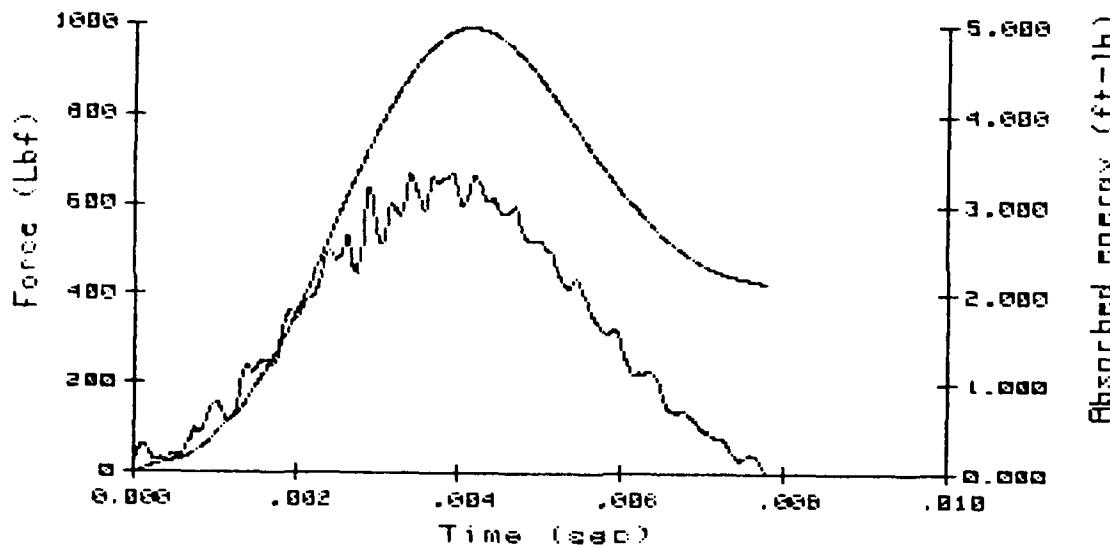
1/4/84

=====
INSTRUMENTED IMPACT TEST
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5245 GR/BMI #2

Drop weight = 7.00LB Data disk MAT00606
 Tup radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 6.67ft/s abs(V_f) = 6.06ft/s
 K.E. = 4.83ft-Lb V_f (calc) = -5.02ft/s

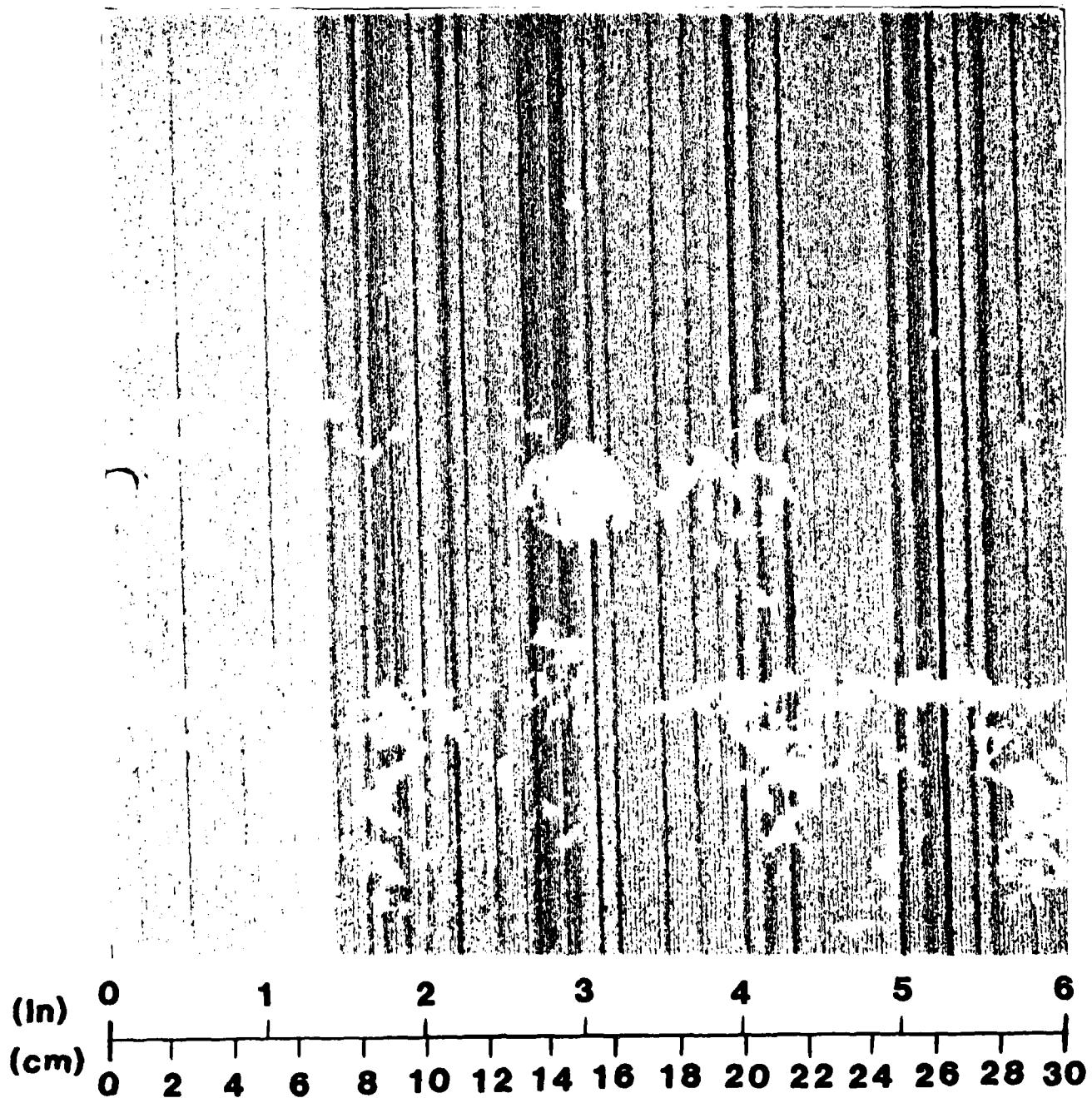
Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
672.6	3.895E-3	4.91	.2260	Maximum force
649.2	4.145E-3	4.96	.2270	Maximum energy
649.2	4.145E-3	4.96	.2270	Maximum displacement
7.2	7.775E-3	2.13	.0754	Final values



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5245 GR/BMI

#2

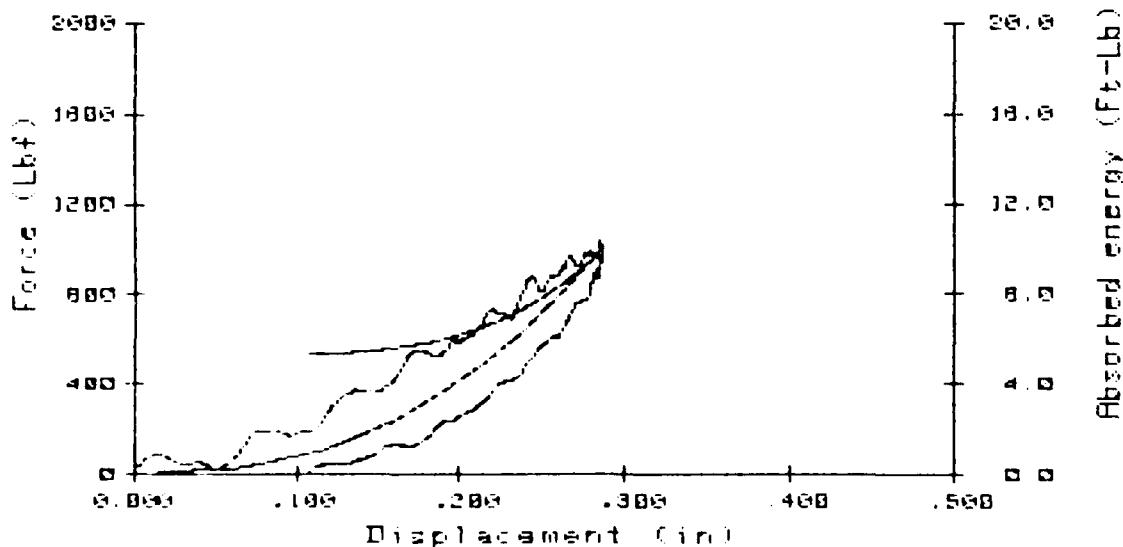
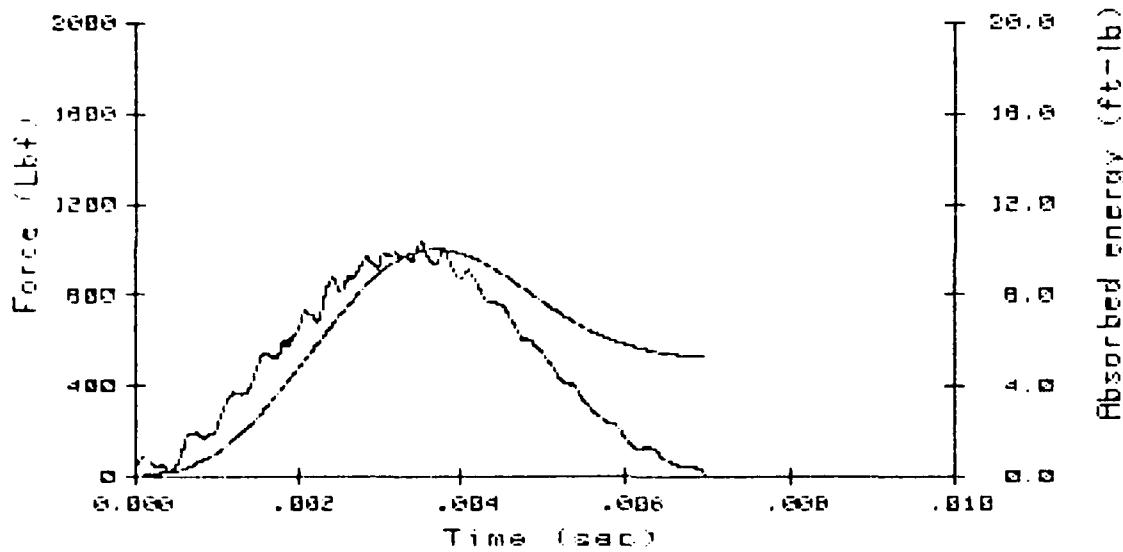


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 INSTRUMENTED IMPACT TEST
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5245 GR/BMI #3

Drop weight =	7.00Lb	Data disk =	MAT00607
Tup radius =	.500in	DRM scale	.8Kg/Div
Temperature =	74.0 F	Flag grid =	.040in
V ₀ =	9.52ft/s	abs(V _f) =	8.13ft/s
K.E. =	9.86ft-Lb	V _f (calc) =	-6.49ft/s

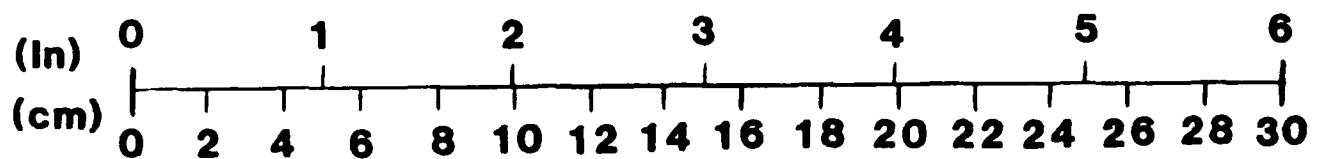
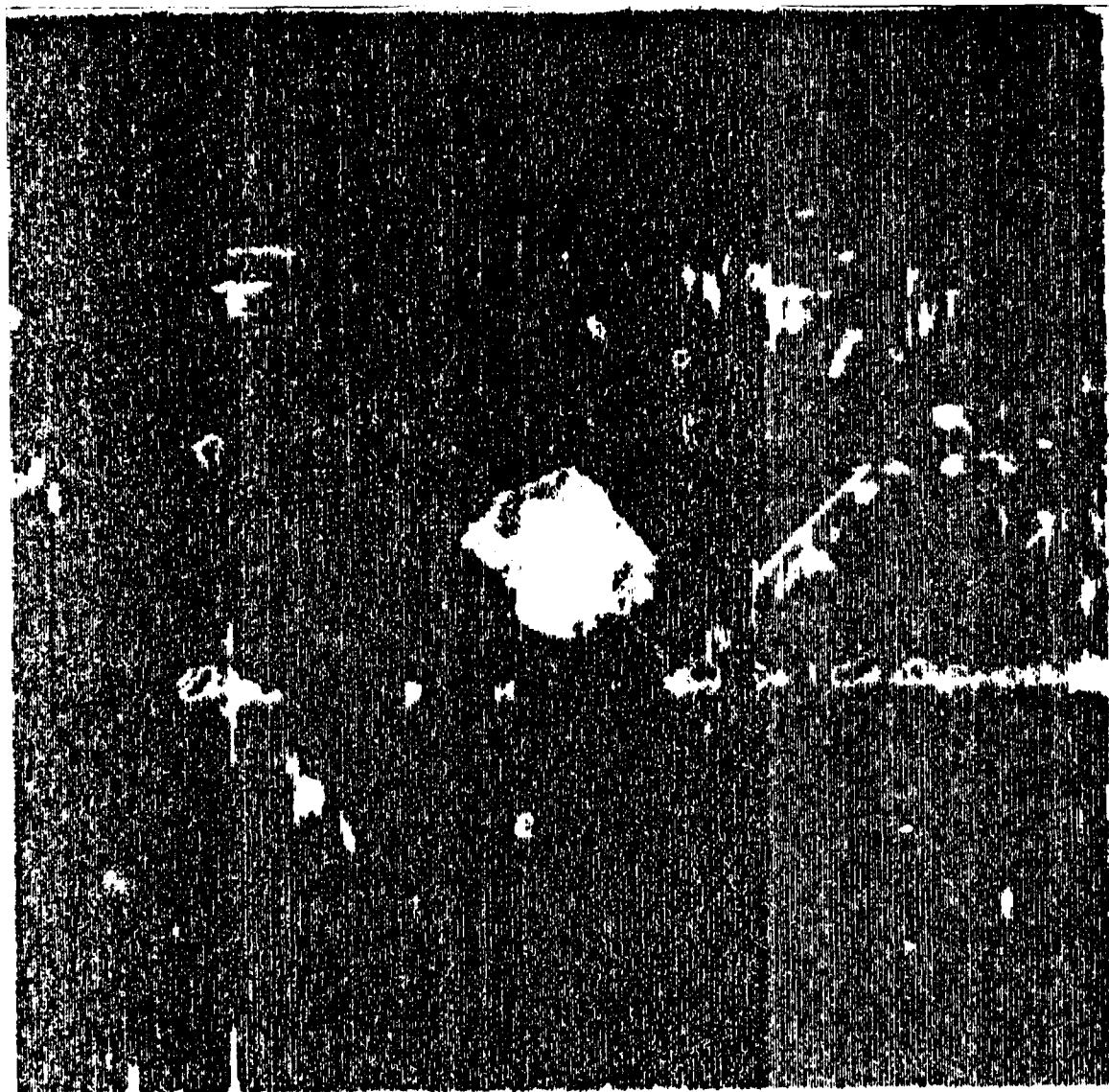
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
1034.1	3.505E-3	9.94	.2853	Maximum force
944.2	3.705E-3	10.03	.2863	Maximum energy
944.2	3.705E-3	10.03	.2863	Maximum displacement
16.2	6.945E-3	5.34	.1086	Final values



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5245 GR/BMI

#3

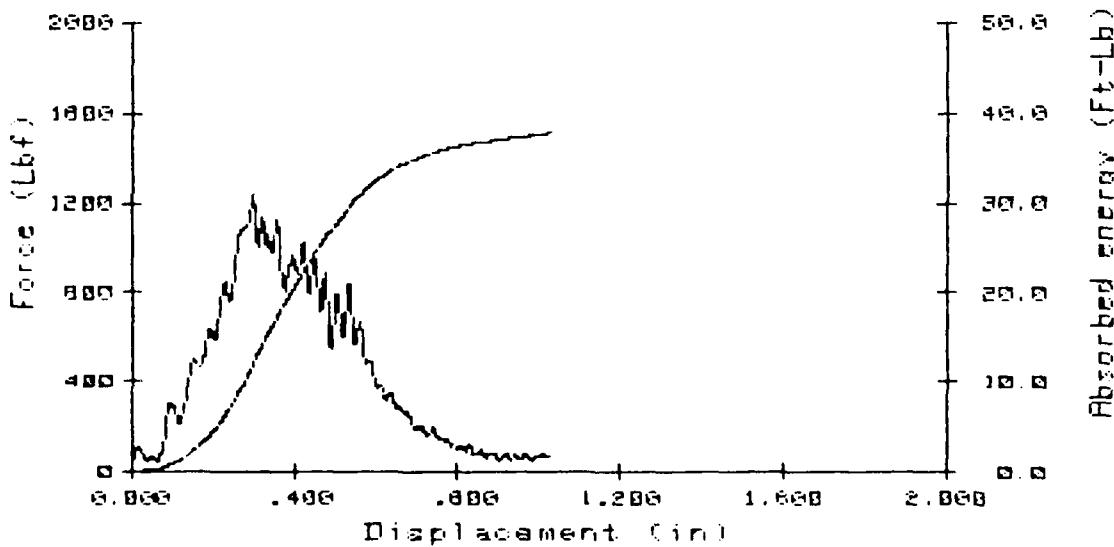
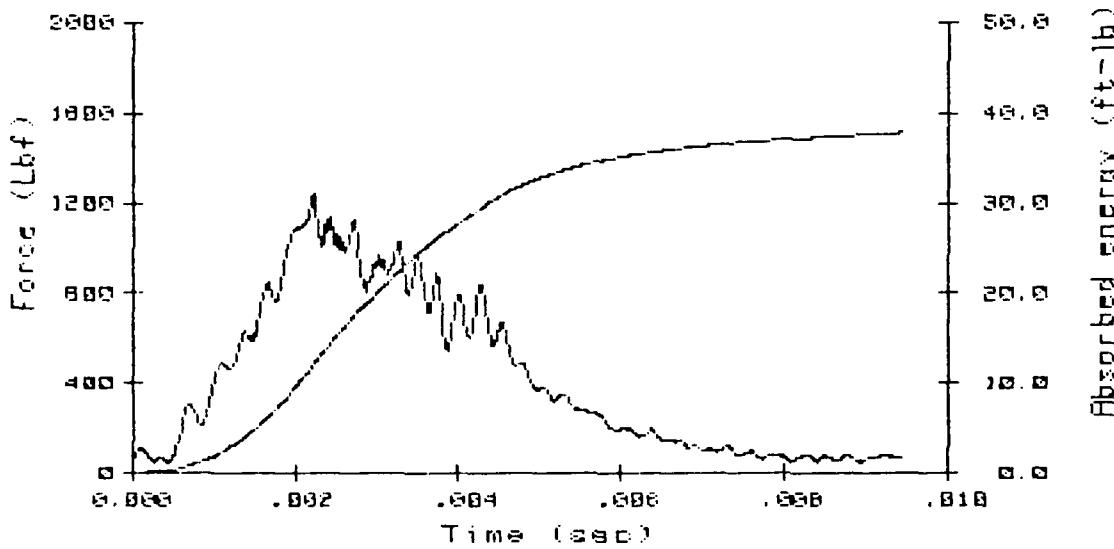


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 INSTRUMENTED IMPACT TEST
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5245 GR/BMI #4 CECILIAN 1C

Drop weight =	31.36Lb	Data disk =	MAT00608
Tup radius =	.500in	DRM scale =	.8Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V ₀ =	11.49ft/s		
K.E. =	64.34ft-Lb	V _f (calc) =	7.74ft/s

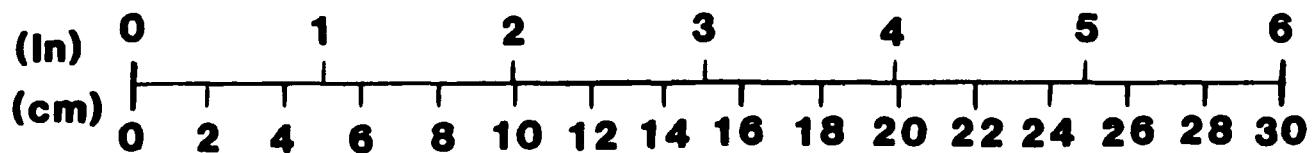
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
1237.3	2.225E-3	12.21	.3009	Maximum force
64.7	9.445E-3	37.85	1.0271	Maximum energy
64.7	9.445E-3	37.85	1.0271	Maximum displacement
64.7	9.445E-3	37.85	1.0271	Final values



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5245 GR/BMI

#4



NADC-85023-60

DRM - T-1520000 DROP TEST FACILITY

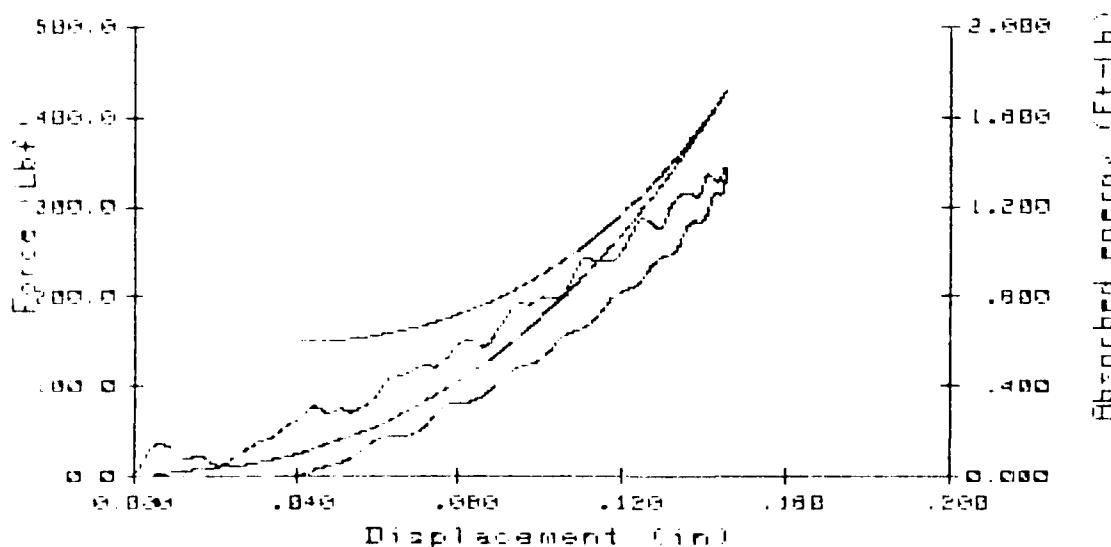
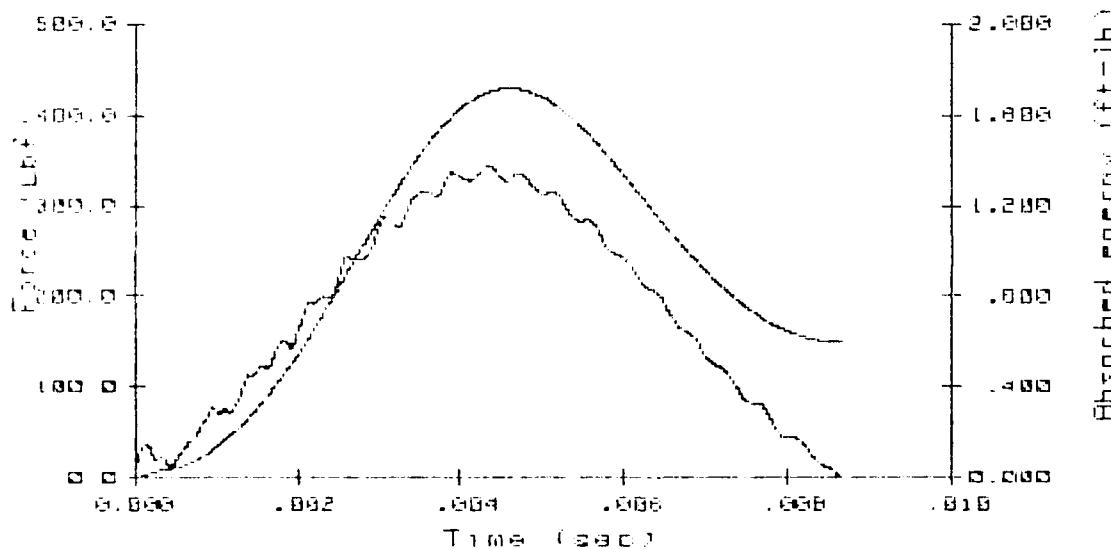
DATA SHEET

INSTRUMENTED IMPACT TEST

TEST ID: 1045 09-18M1 #6

Drop weight	=	7.000 lb	Data disk	MAT00902
Imp. radius	=	.500in	DRM scale	.2Kg/Div
Temperature	=	74.0 F	Flag grid	.040in
V0	=	3.88ft/s	abs(Vf)	= 3.70ft/s
F.E.	=	1.63ft-lb	Vf(calc)	= -3.12ft/s

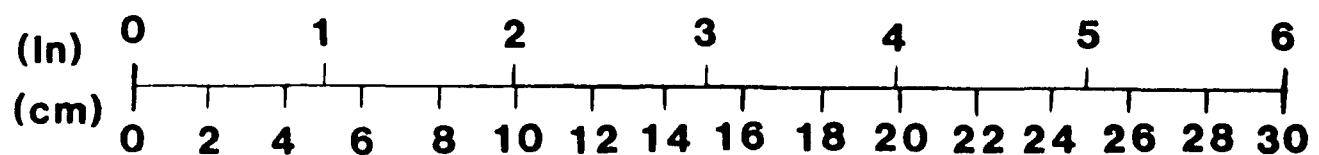
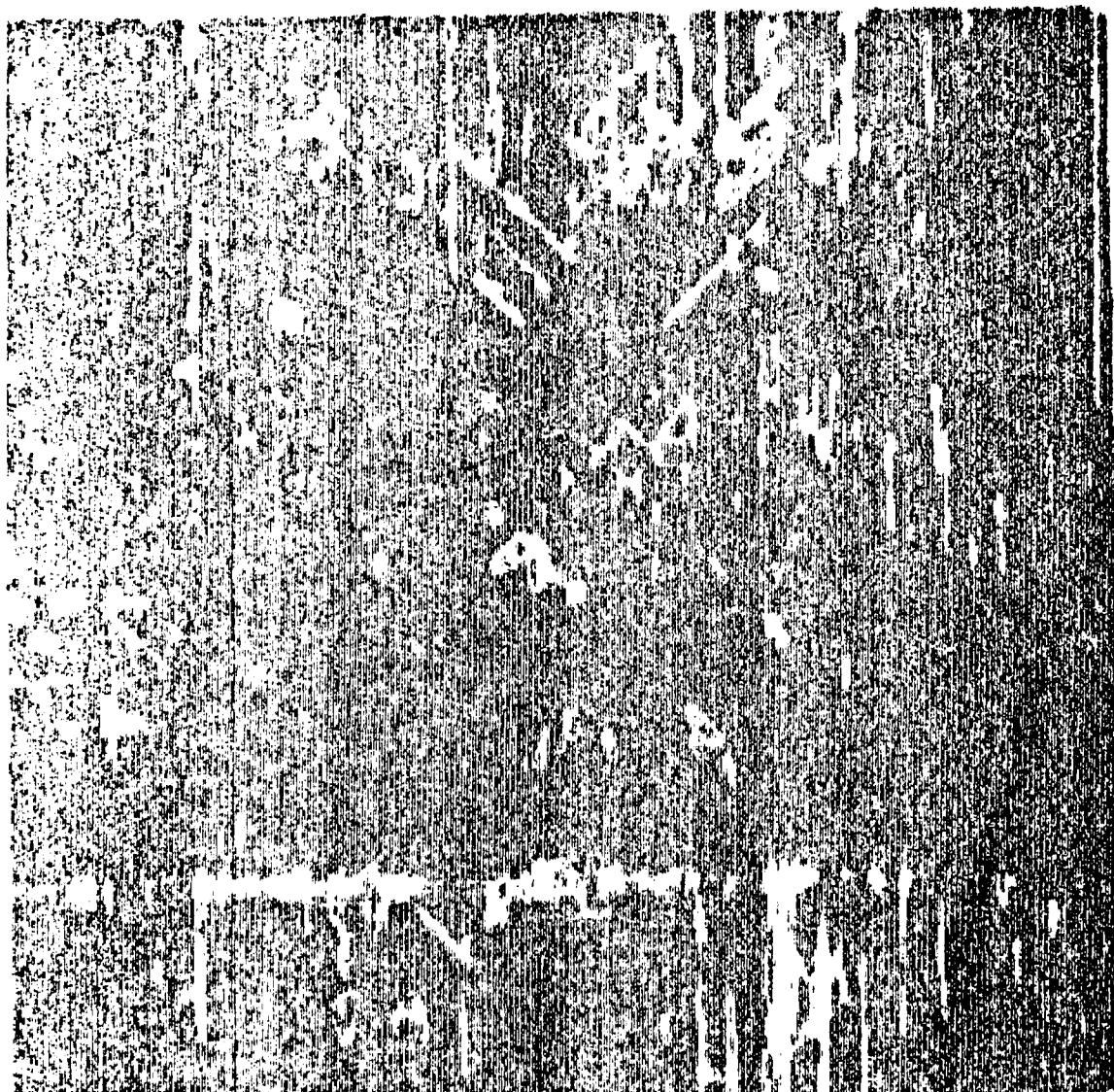
Load(lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
343.9	4.585E-3	1.70	.1446	Maximum force
327.9	4.595E-3	1.72	.1451	Maximum energy
327.9	4.595E-3	1.72	.1451	Maximum displacement
1.4	8.665E-3	.60	.0411	Final values



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5245 GR/BMI

#6

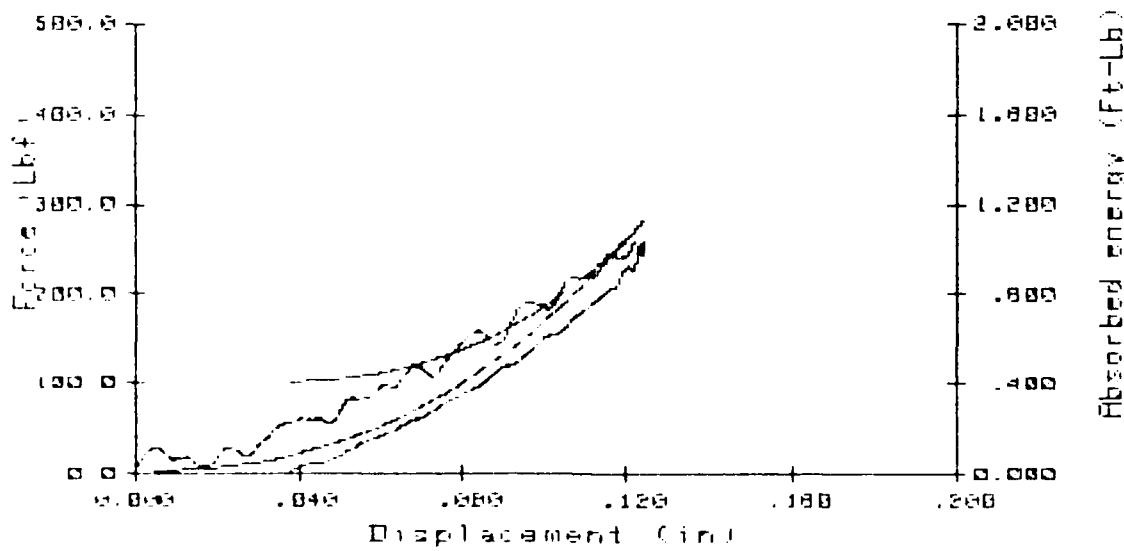
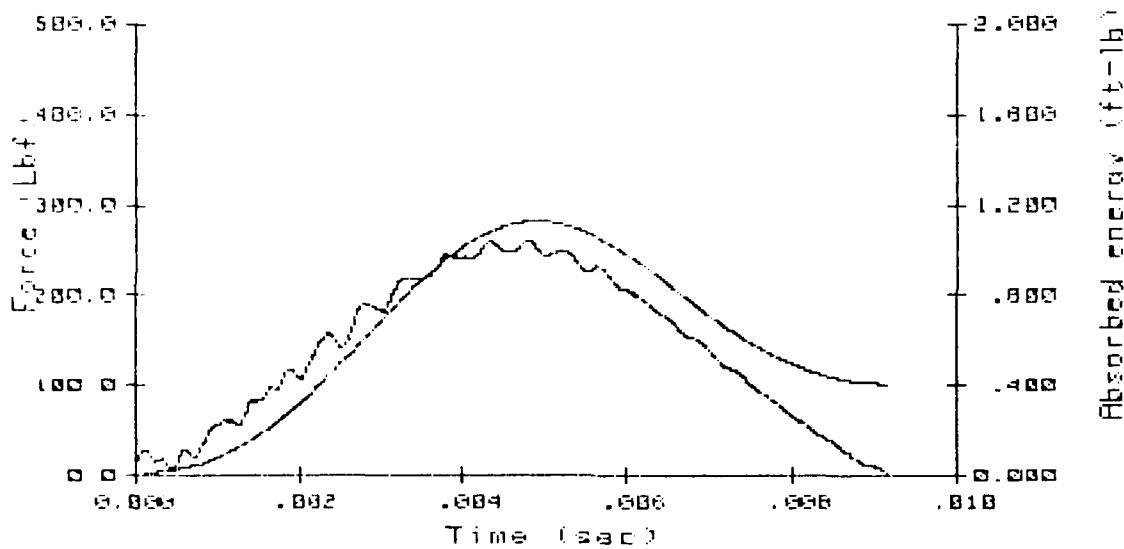


INSTRUMENTED IMPACT TEST

S245 GR/BMI #7

Drop weight = 7.000lb Data disk MAT01005
 Tup radius = .500in DRM scale .2Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 3.12ft/s abs(V_f) = 3.00ft/s
 E.E. = 1.05ft-Lb V_f (calc) = -2.48ft/s

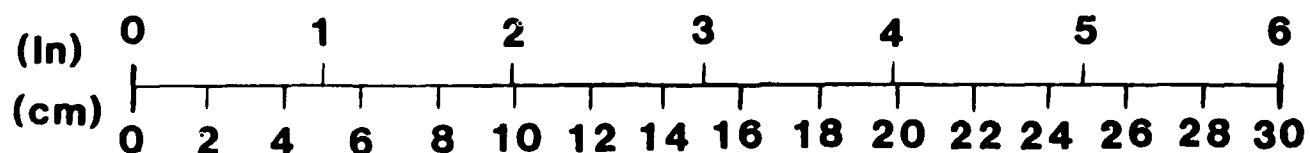
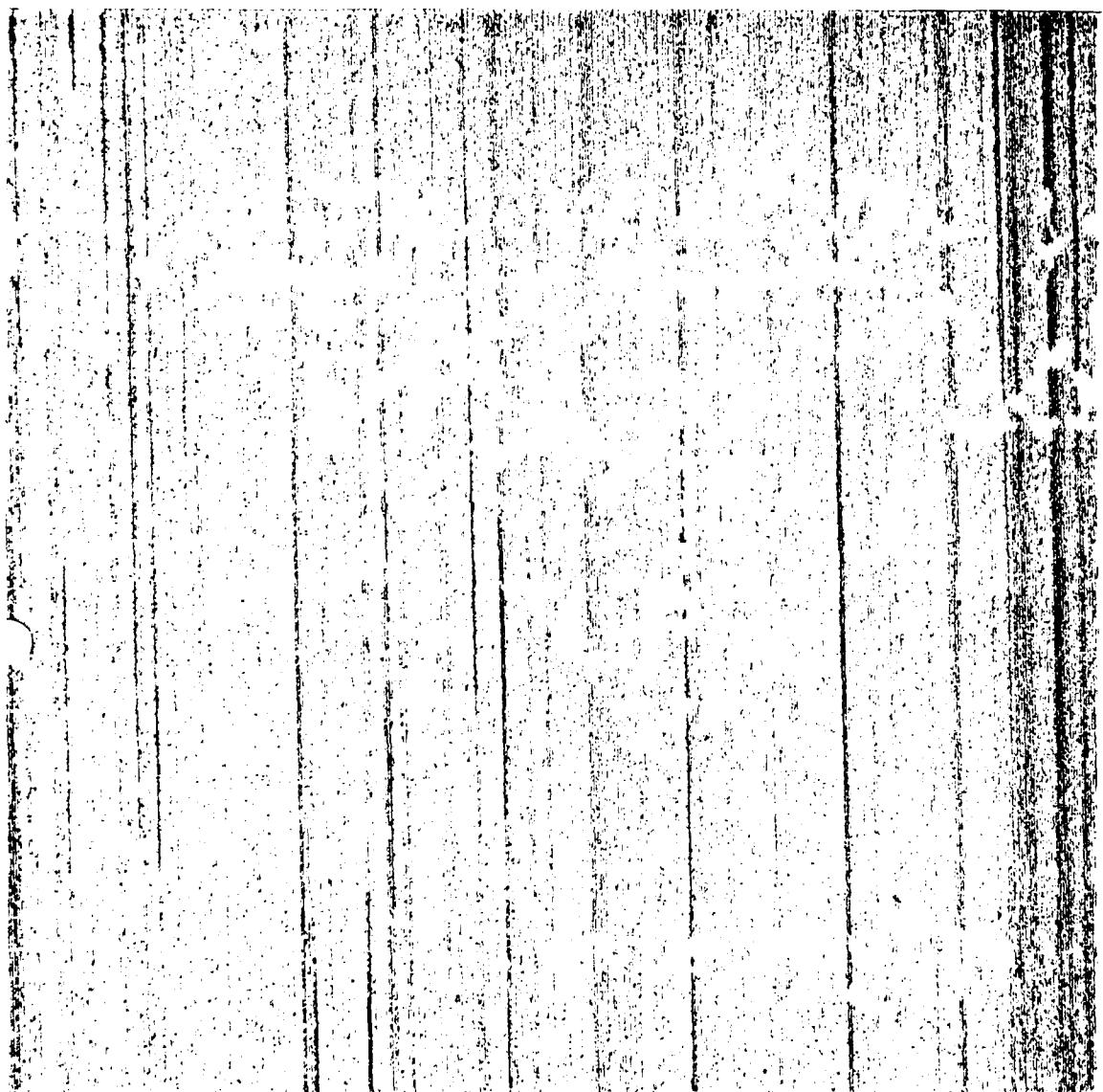
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
260.3	4.785E-3	1.13	.1240	Maximum force
251.8	4.895E-3	1.13	.1241	Maximum energy
251.8	4.895E-3	1.13	.1241	Maximum displacement
4.0	9.135E-3	.41	.0383	Final values



NADC-85023-60

5245 GR/BMI

#7



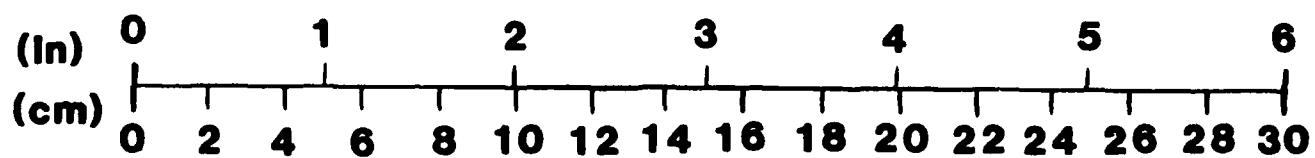
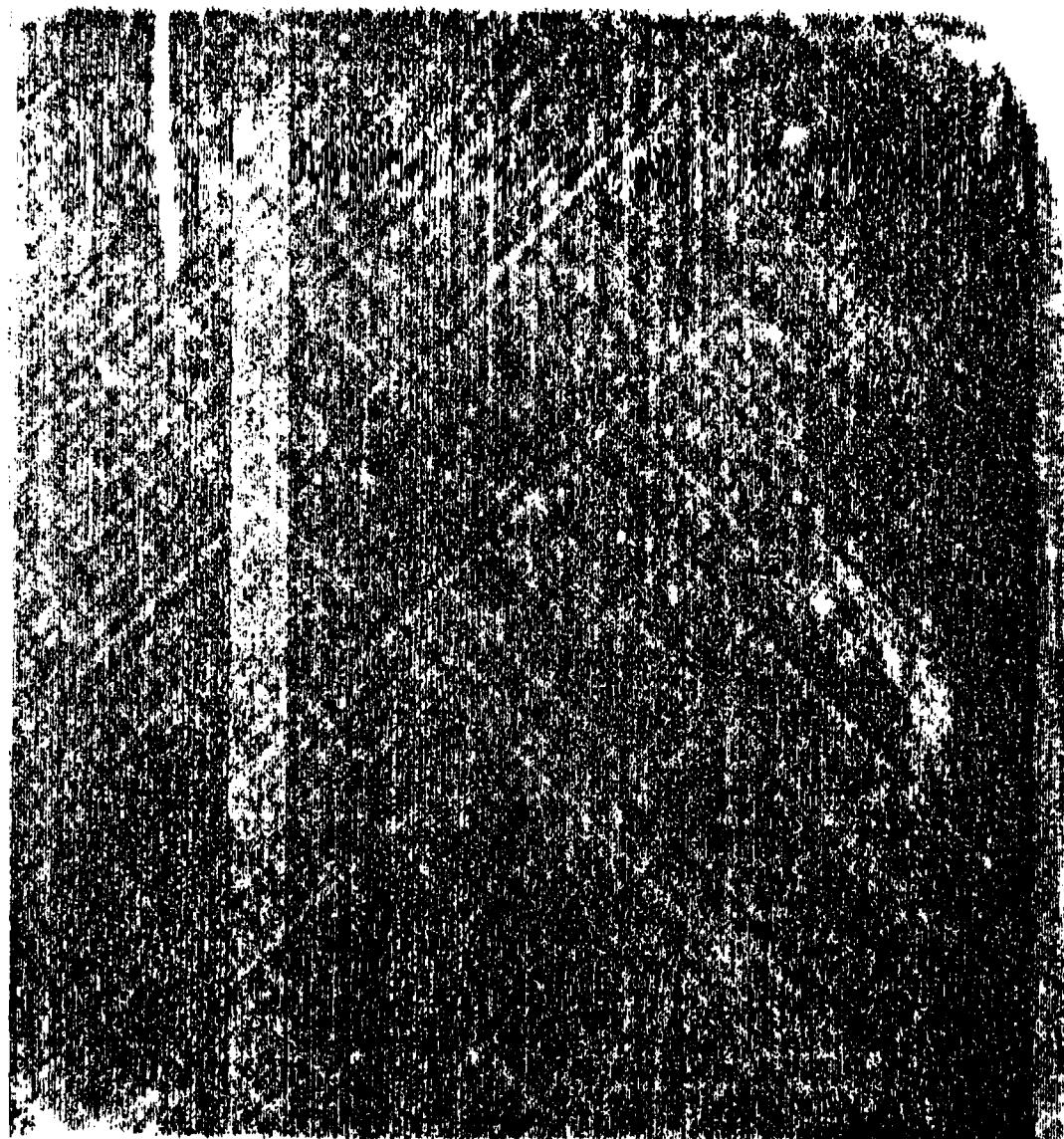
NADC-85023-60

IM6/5245C

NADC-85023-60

GR/BMI 5245C

CONTROL



NADC-85023-60

NADC/ET1-8200 DROP TEST FACILITY

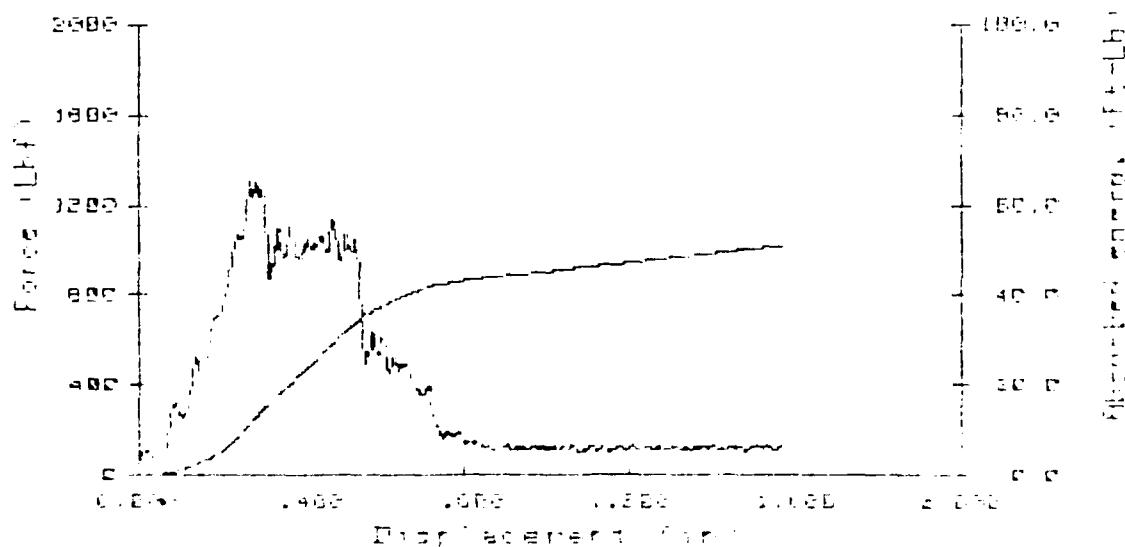
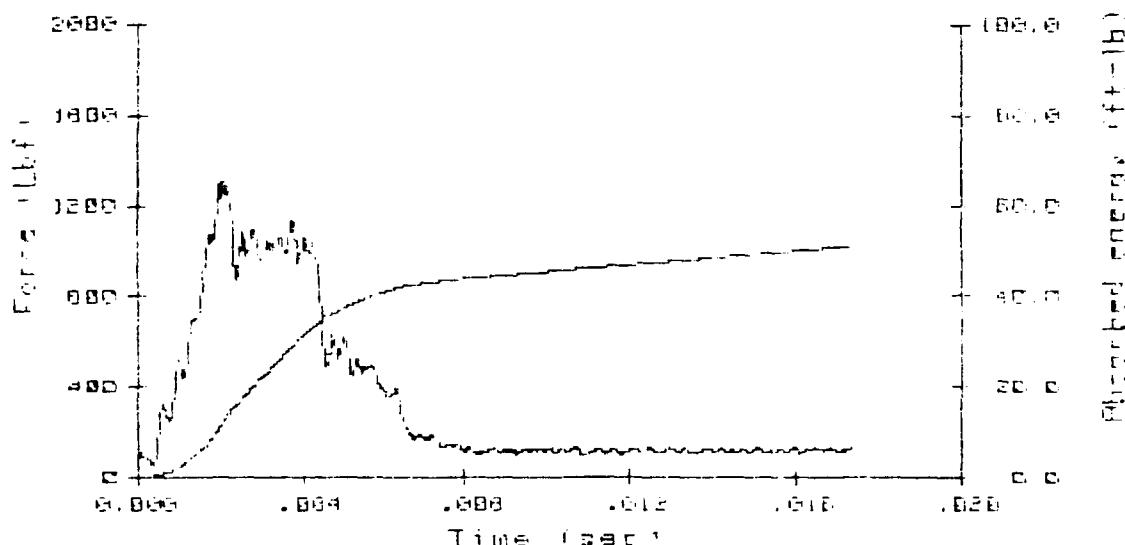
4/26/84

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INSTRUMENTED IMPACT TEST
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GR/BMI S245C #1

Drop weight =	31.36Lb	Data disk =	MAT01108
Tup radius =	.500in	DRM scale =	.8Kg/Div
Temperature =	74.0 F	Flag grid =	.040in
V_0 =	11.49ft/s		
I.E. =	64.34ft-Lb	V_f (calc) =	5.97ft/s

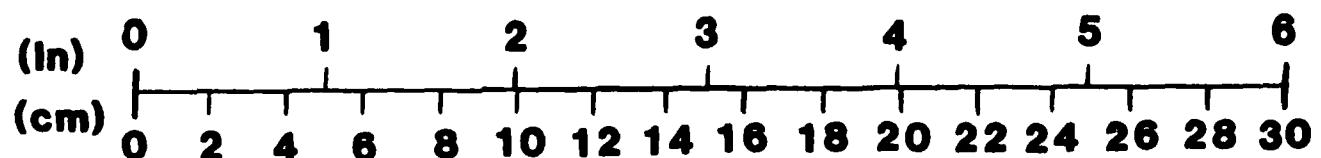
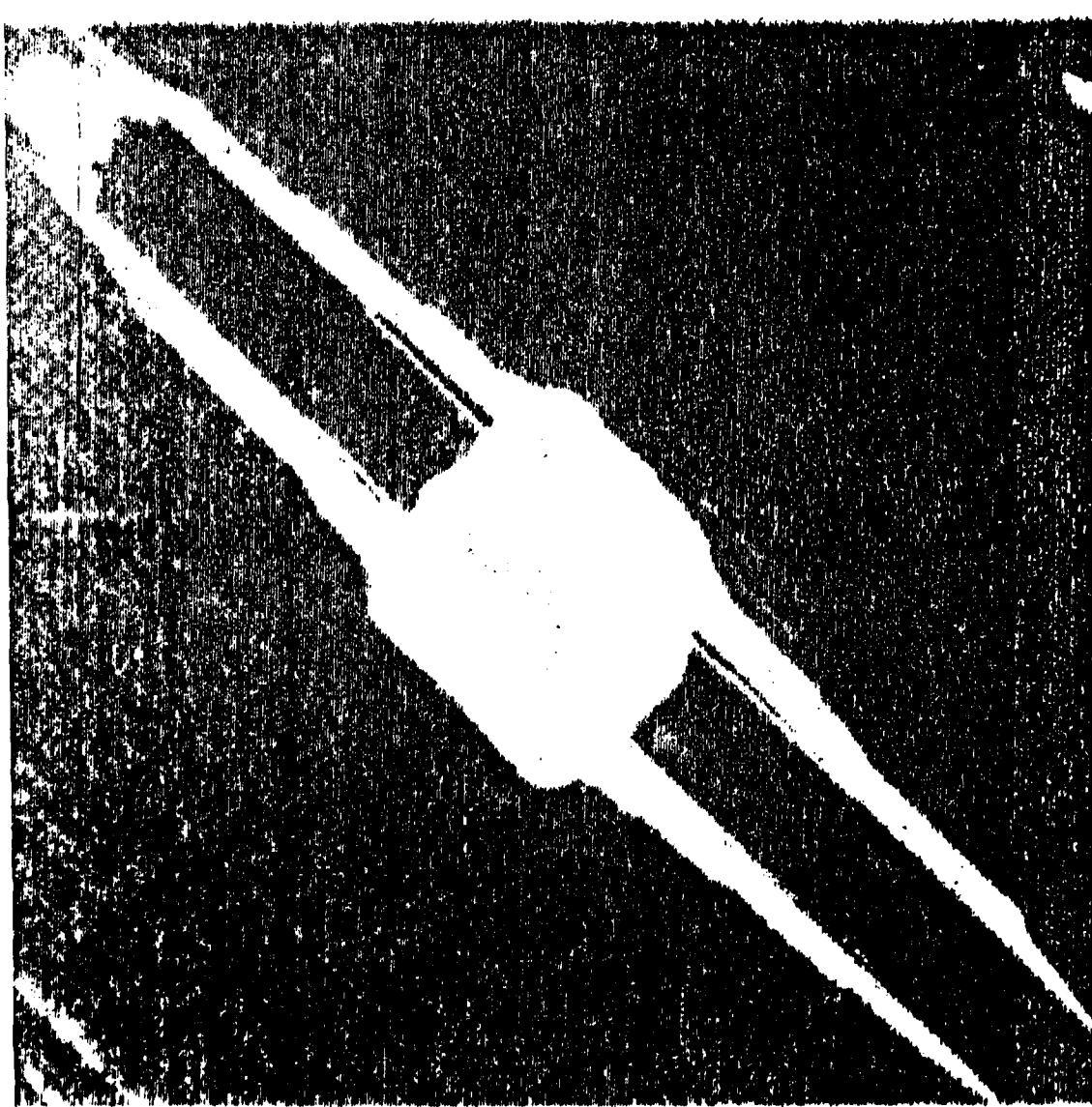
Load (Lb)	Time (s)	E_0 (Ft-Lb)	Disp (in)	
1309.3	1.985E-3	11.14	.2692	Maximum force
127.7	1.735E-2	51.06	1.5661	Maximum energy
127.7	1.735E-2	51.06	1.5661	Maximum displacement
127.7	1.735E-2	51.06	1.5661	Final values



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GR/BMI 5245C

#1



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

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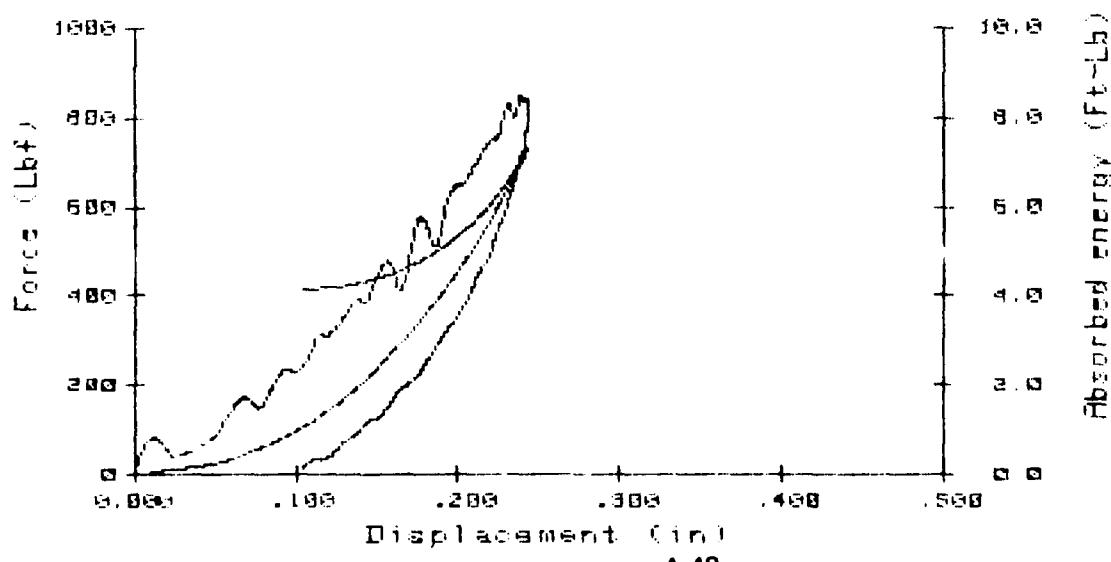
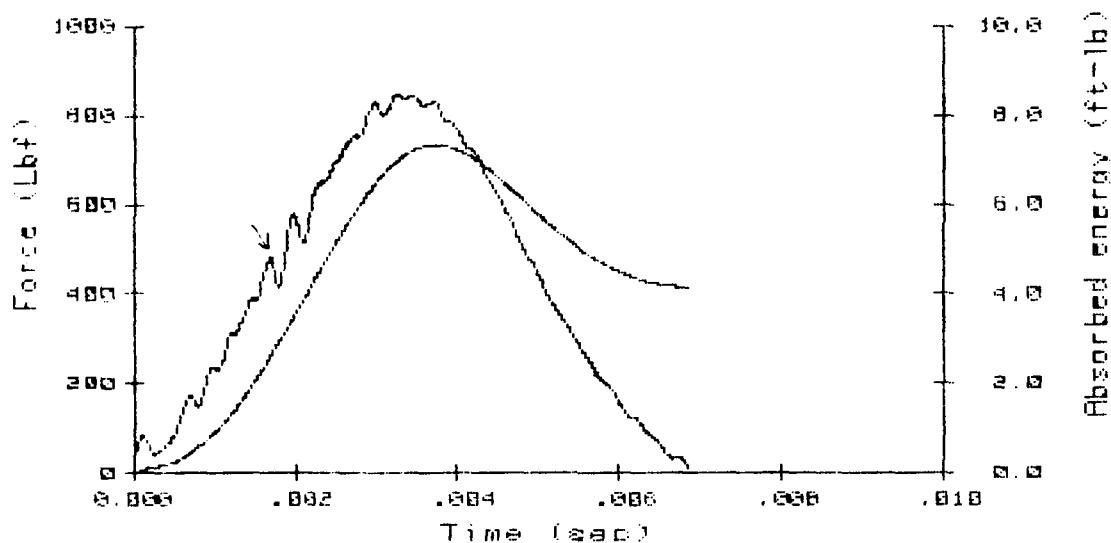
INSTRUMENTED IMPACT TEST

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GR/BMI 5245C #2

Drop weight =	7.00Lb	Data disk =	MAT01106
Tup radius =	.500in	DRM scale	.8Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V ₀ =	8.13ft/s	abs(V _f) =	7.09ft/s
K.E. =	7.18ft-Lb	V _f (calc) =	-5.35ft/s

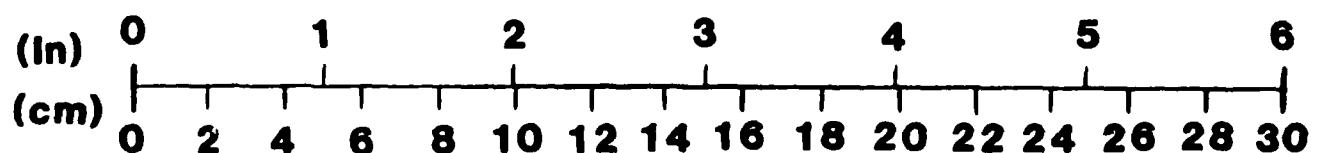
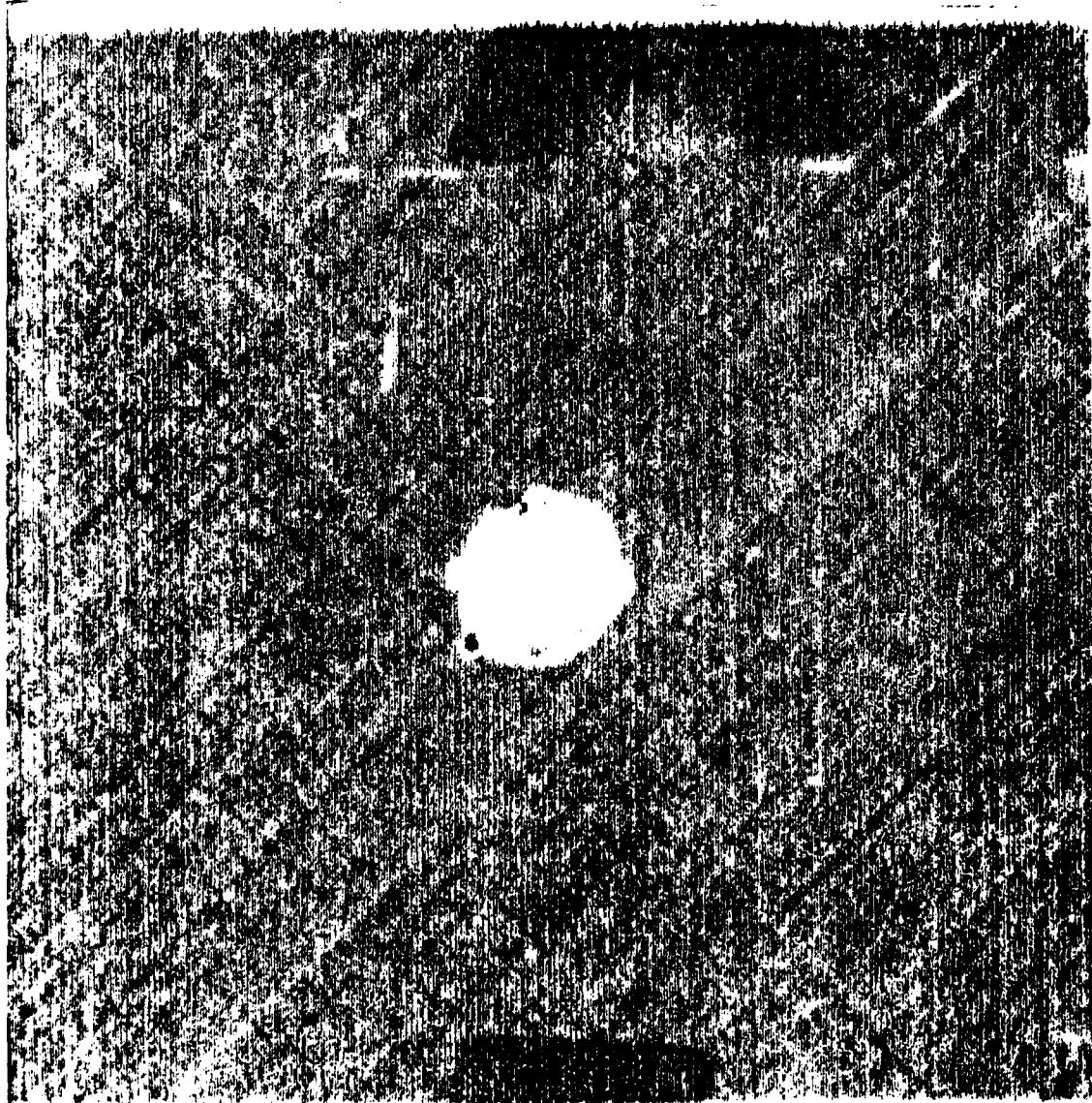
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
482.0	1.685E-3	2.59	.1558	Initial damage
848.9	3.245E-3	6.96	.2390	Maximum force
832.7	3.725E-3	7.33	.2442	Maximum energy
832.7	3.725E-3	7.33	.2442	Maximum displacement
14.4	6.855E-3	4.14	.1042	Final values



NADC-85023-60

GR/BMI 5245C

#2

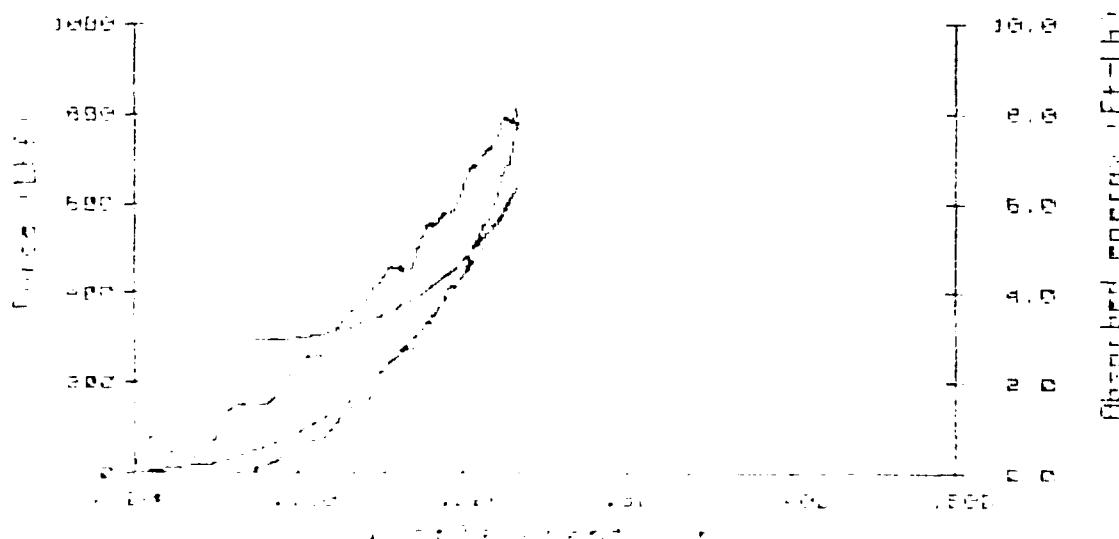
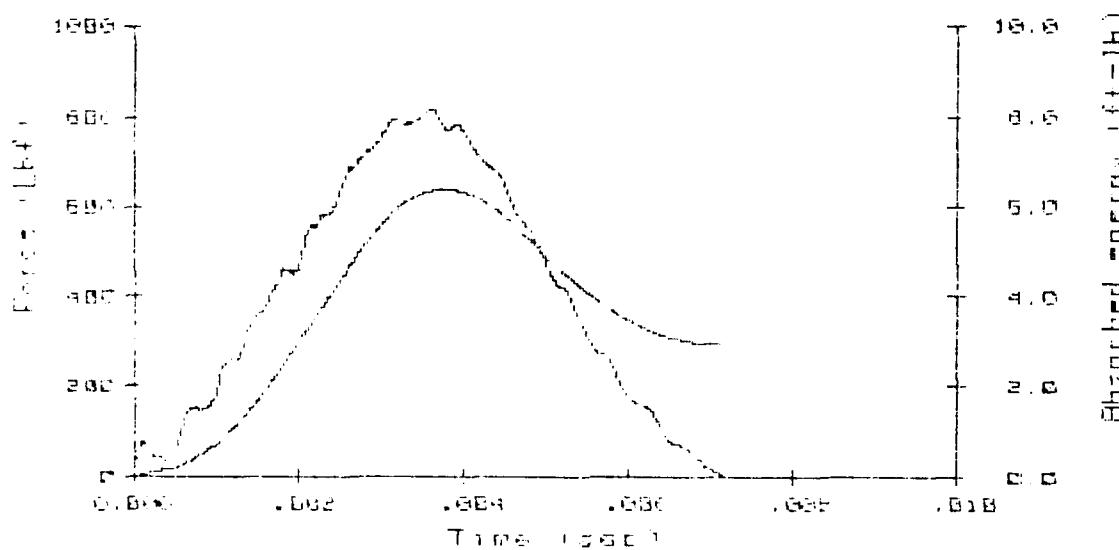


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INSTRUMENTED IMPACT TEST
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GH/EMI 5245C #3A

Drop weight = 7.00LB Data disk MAT01105
 Tip radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 7.58ft/s abs(Vf) = 6.94ft/s
 F.E. = 6.24ft-Lb Vf(calc) = -5.54ft/s

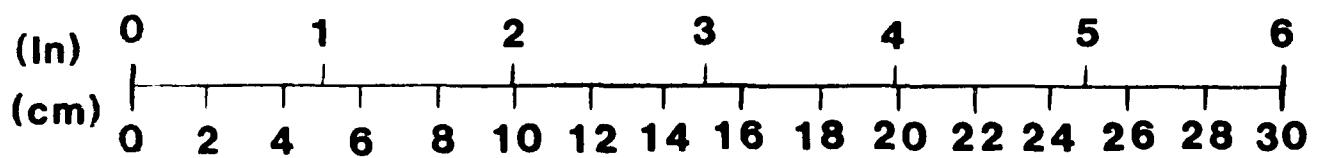
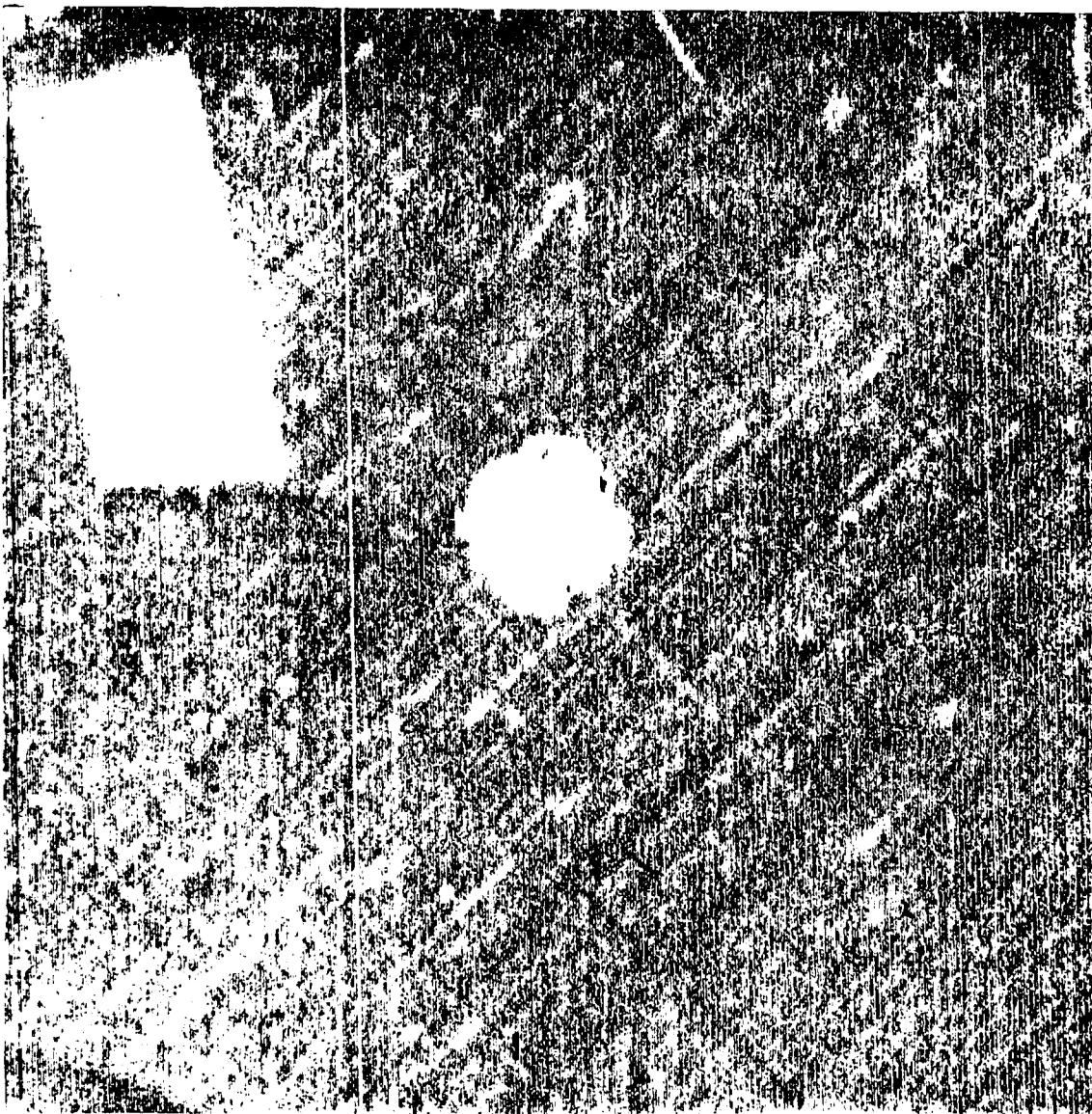
Load (Lb)	Time(s)	E0 (Ft-Lb)	Disp (in)	
817.4	3.605E-3	6.34	.2314	Maximum force
774.2	3.755E-3	6.37	.2318	Maximum energy
774.2	3.755E-3	6.37	.2318	Maximum displacement
8.1	7.125E-3	2.94	.0743	Final values



NADC-85023-60

GR/BMI 5245C

#3

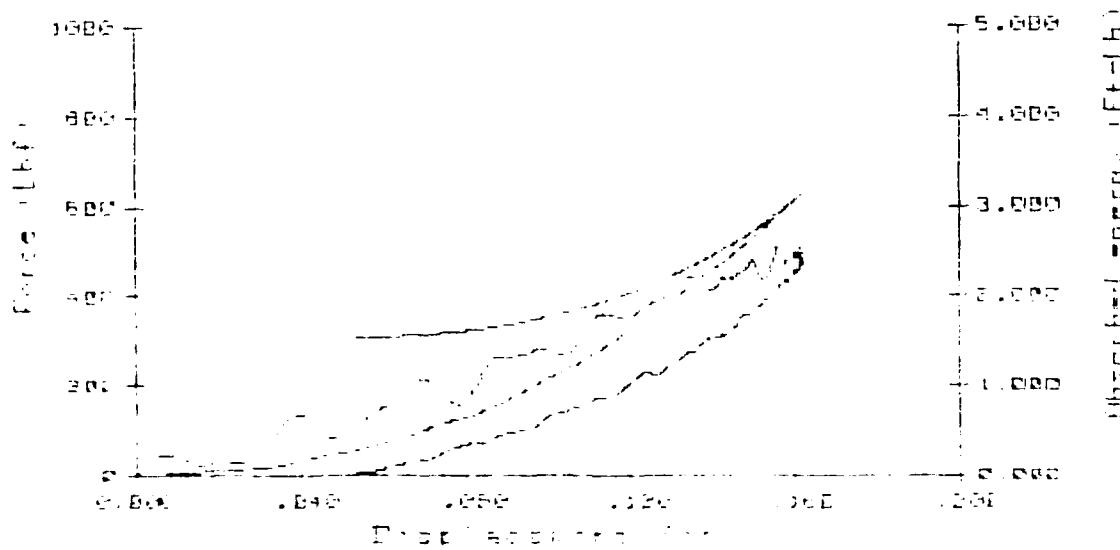
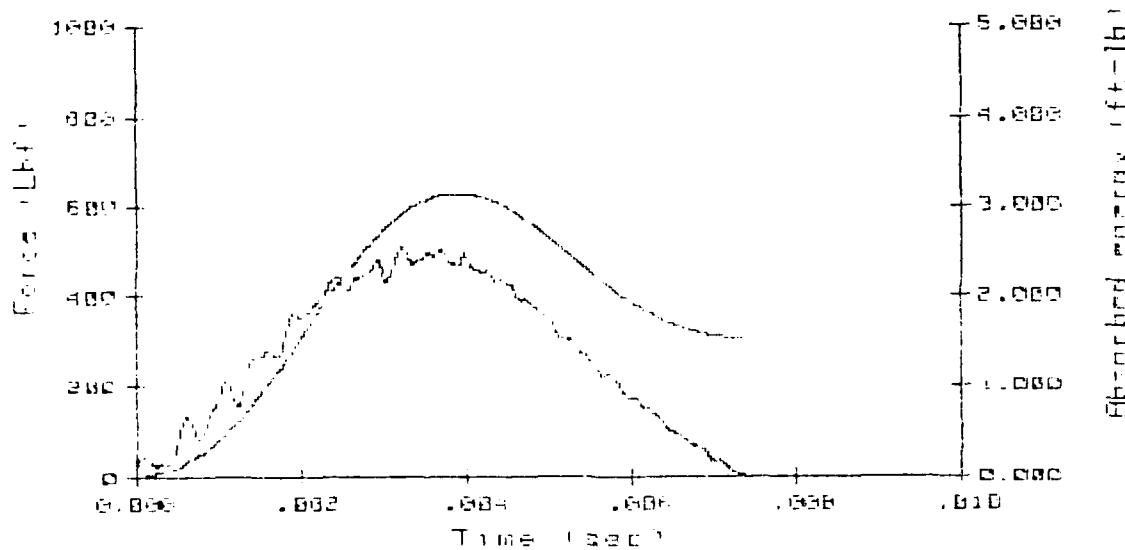


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INSTRUMENTED IMPACT TEST
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GR/EMI 5245C #4

Drop weight =	7.00lb	Data disk =	MAT01102
Tup radius =	.500in	DRM scale =	.2Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V ₀ =	5.29ft/s	abs(V _f) =	4.76ft/s
F.E. =	3.04ft-Lb	V _f (calc) =	-3.76ft/s

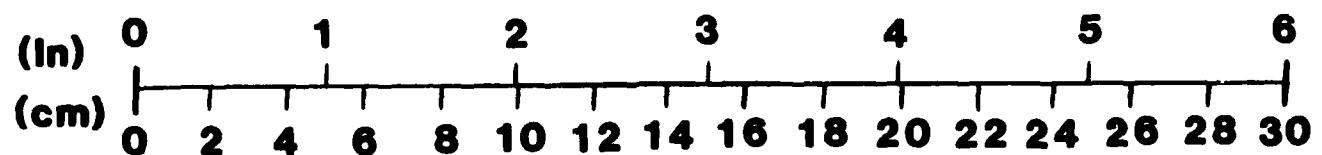
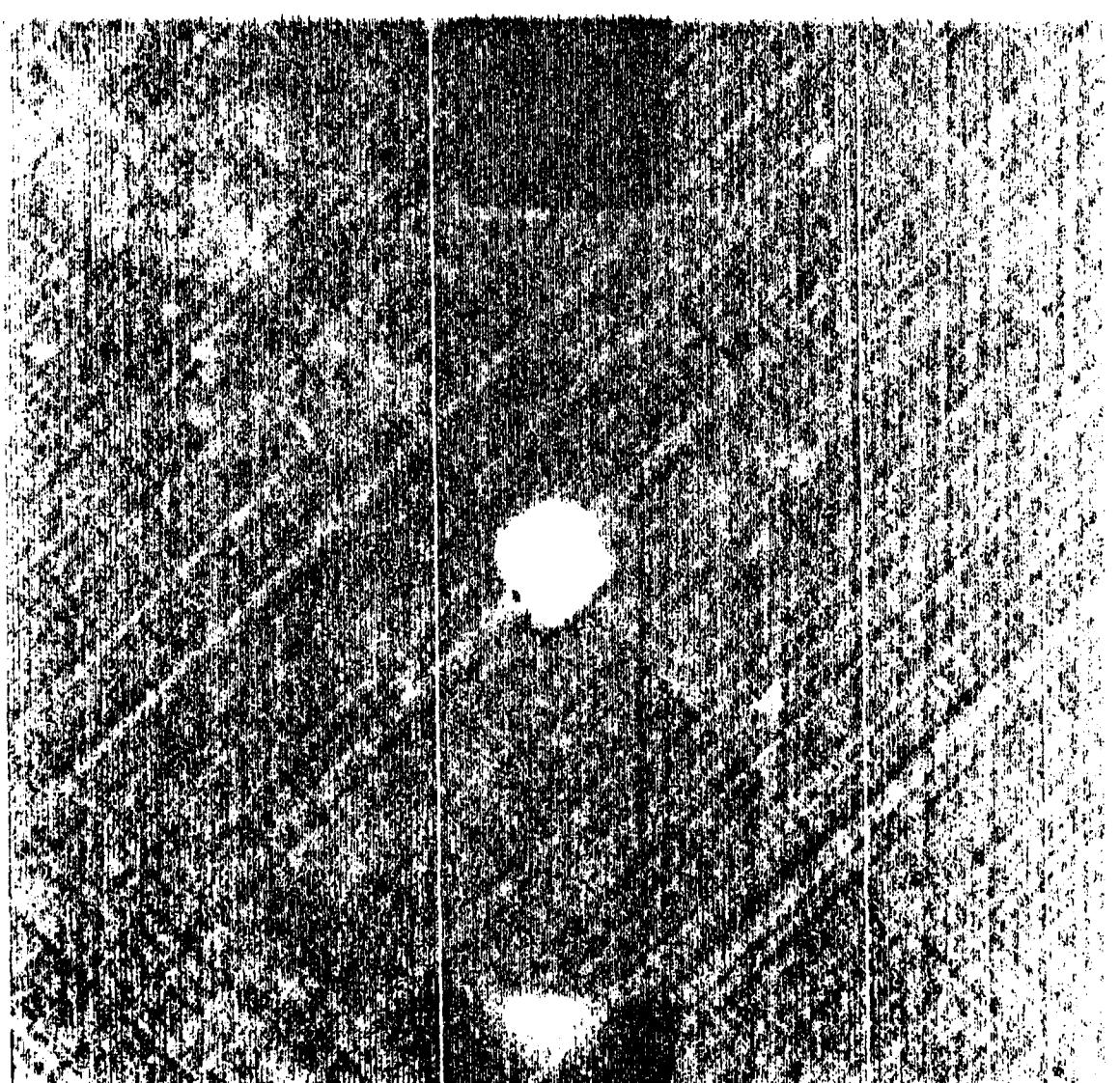
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
510.8	2.215E-3	2.90	.15e1	Maximum force
469.4	3.875E-3	3.14	.1619	Maximum energy
469.4	2.875E-3	3.14	.1619	Maximum displacement
4.0	7.375E-3	1.54	.0537	Final values



NADC-85023-60

GR/BMI 5245C

#4

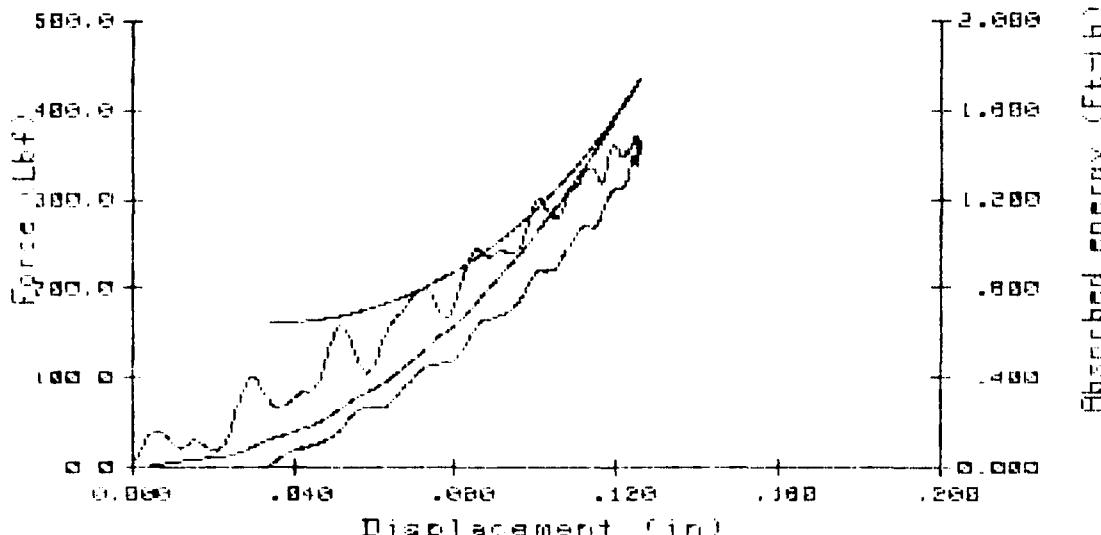
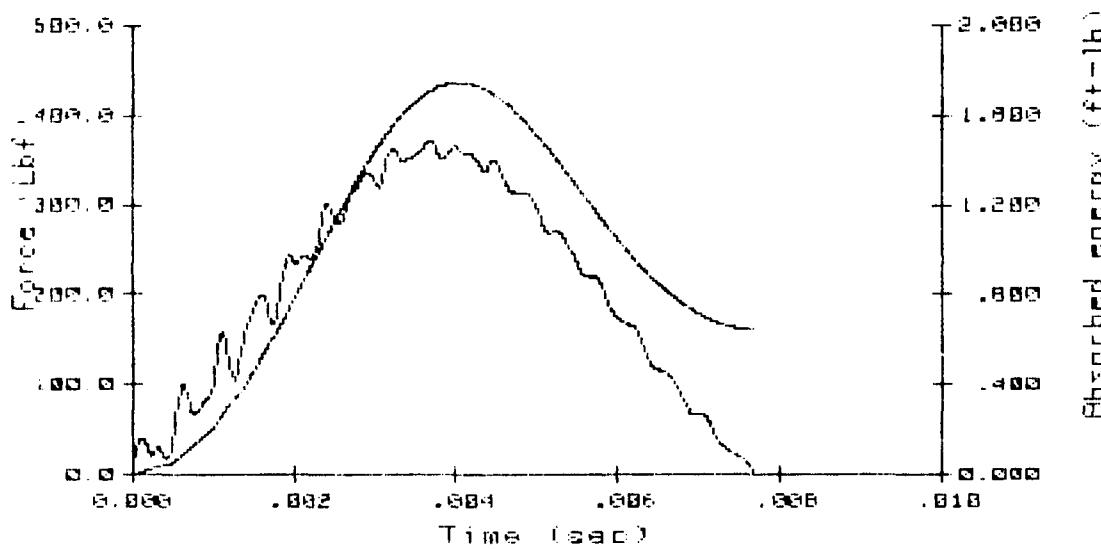


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INSTRUMENTED IMPACT TEST
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GR/BMI 5245C #5

Drop weight = 7.00Lb Data disk MAT01008
 Tup radius = .500in DRM scale .2Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 3.92ft/s abs(V_f) = 3.66ft/s
 K.E. = 1.67ft-Lb V_f (calc) = -3.10ft/s

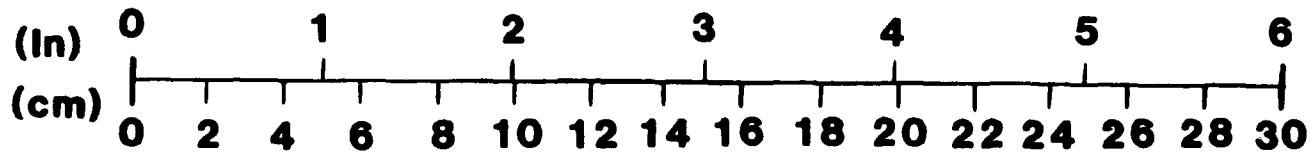
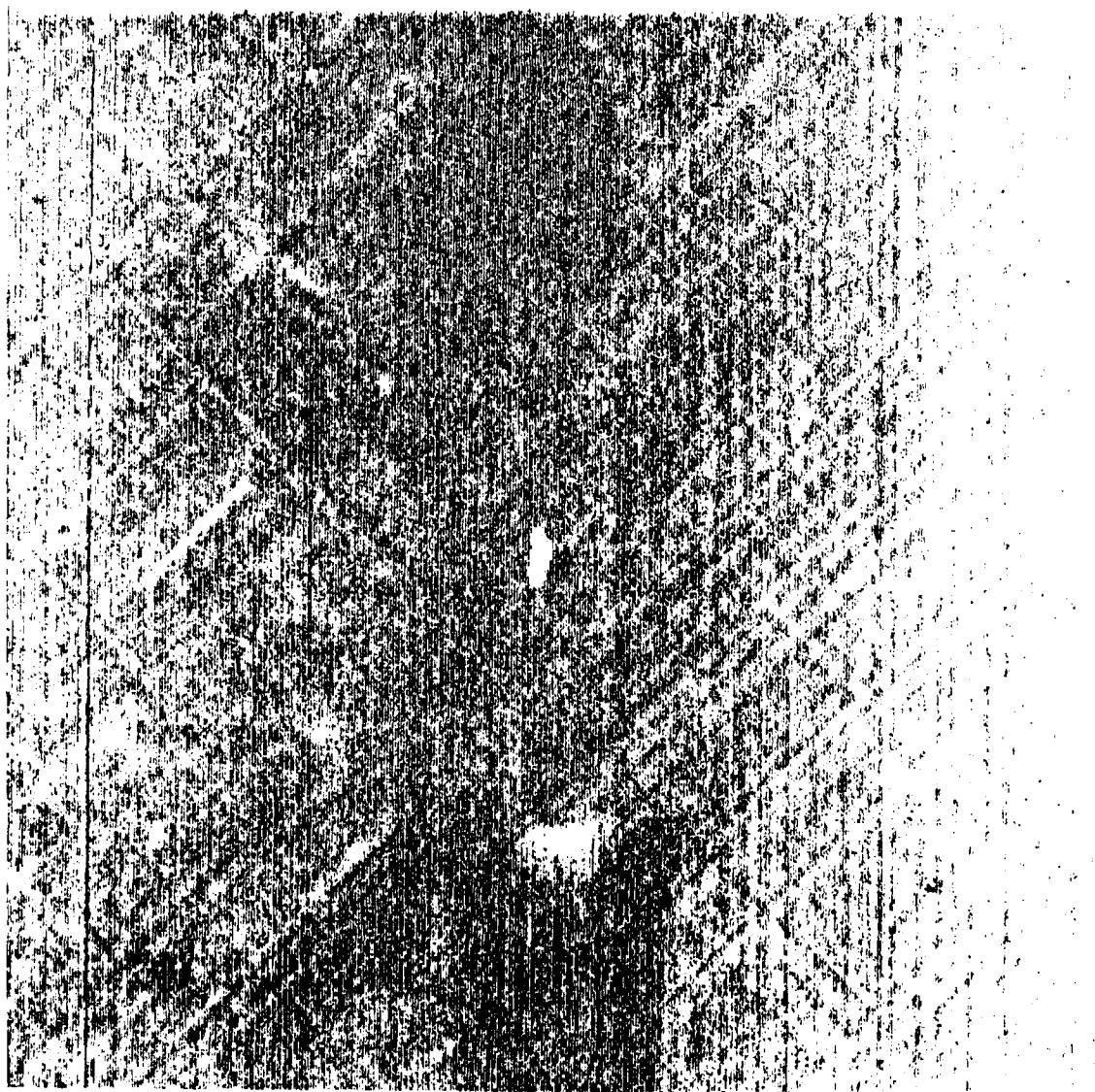
Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
372.3	3.685E-3	1.71	.1246	Maximum force
362.4	4.035E-3	1.74	.1258	Maximum energy
362.4	4.035E-3	1.74	.1258	Maximum displacement
3.6	7.665E-3	.64	.0347	Final values



NADC-85023-60

GR/BMI 5245C

#5



NADC-85023-60

NADC/ETI-82-001 DROF TEST FACILITY

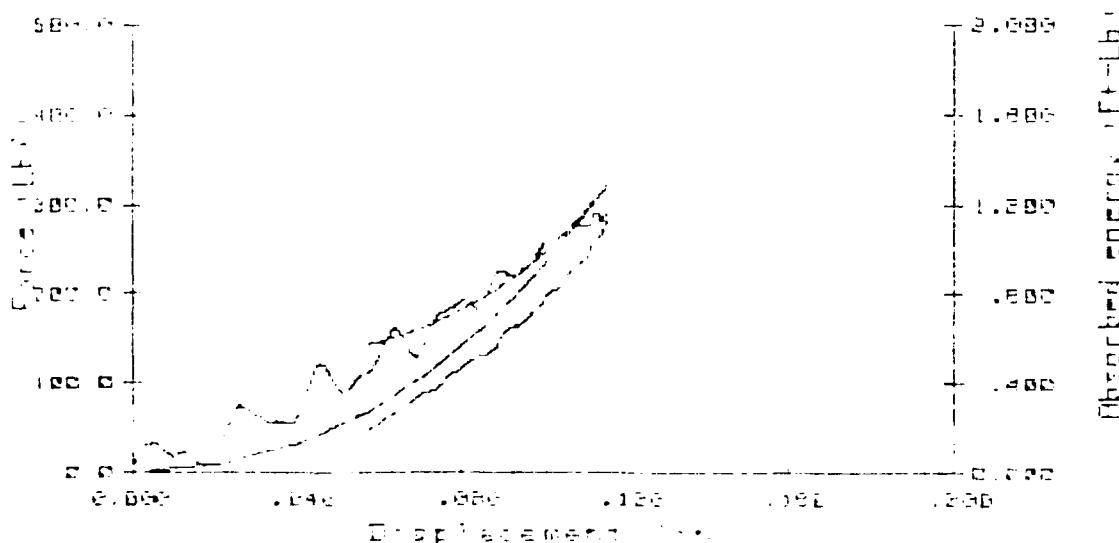
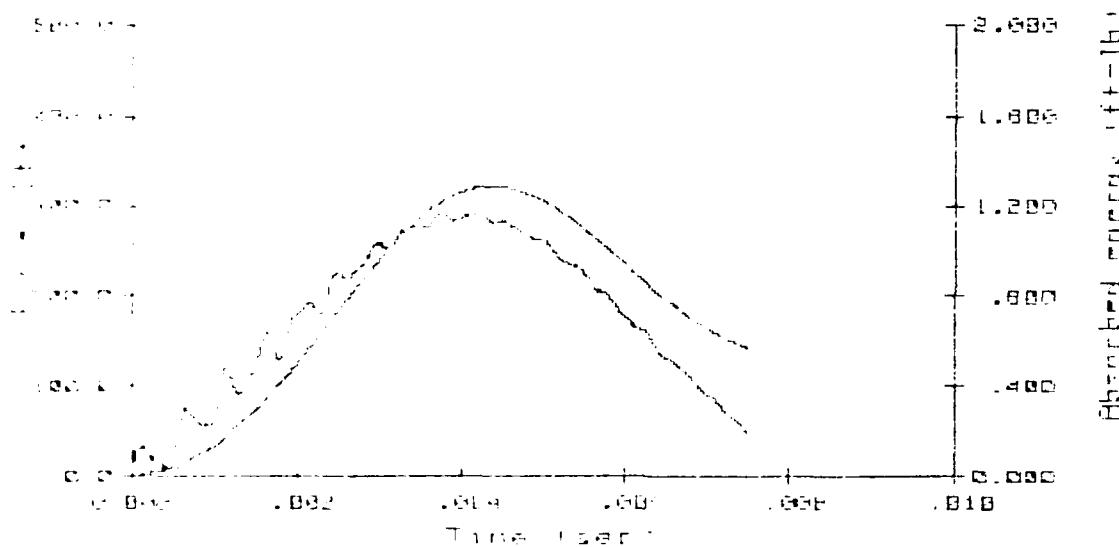
4/26/84

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INSTRUMENTED IMPACT TEST
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GK-BMI 51450 #6

Drop weight = 7.00lb Data disk MAT01006
 Tip radius = .500in DRM scale .2Kn/Div
 Temperature = 74.0 F Flag grid = .040in
 V₀ = 2.35ft/s
 I.E. = 1.22ft-lb V_f(calc) = -2.50ft/s

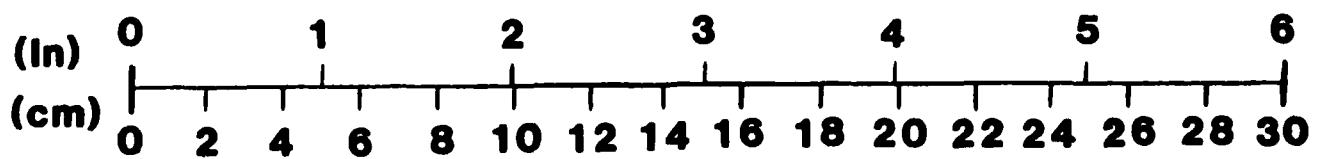
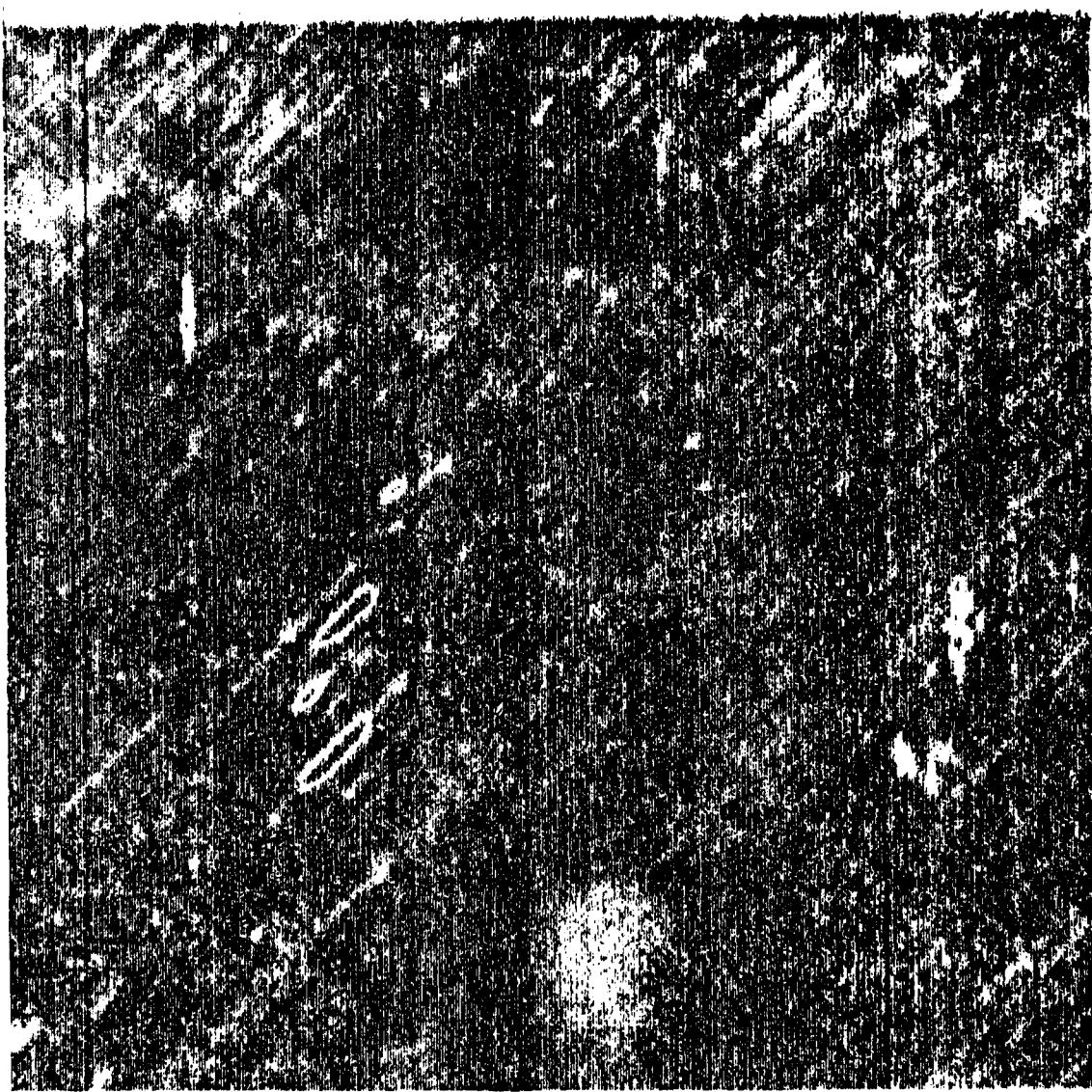
Step	Time(s)	E0(Ft-lb)	Disp(in)	
1	0.000	0.000	0.000	
2	0.004	2.74E-7	1.20	.1130 Maximum force
3	0.004	4.75E-7	1.25	.1159 Maximum energy
4	0.004	4.75E-7	1.25	.1159 Maximum displacement
5	0.010	7.50E-3	.57	.0572 Final values



NADC-85023-60

GR/BMI 5245C

#6



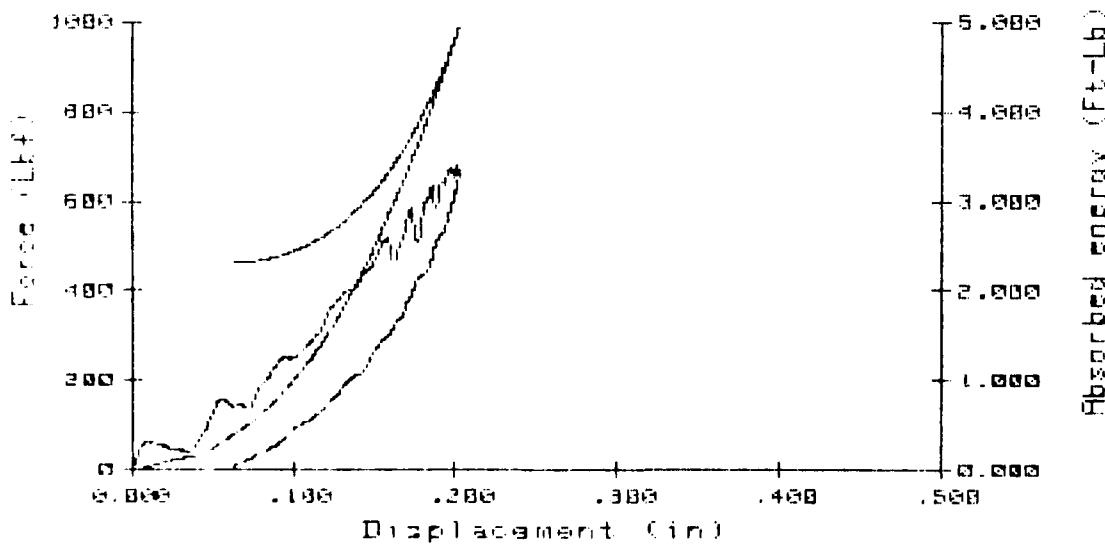
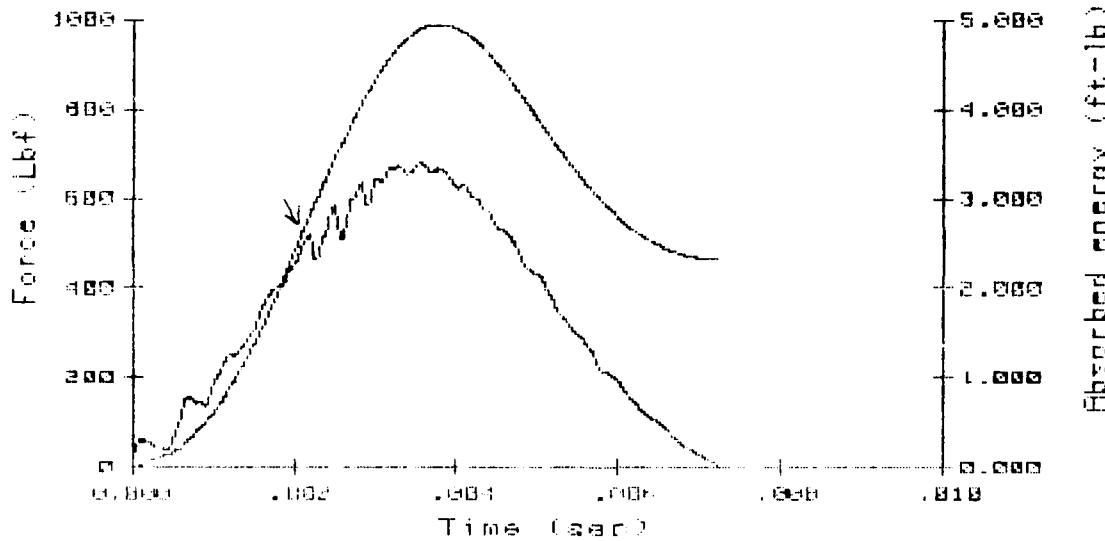
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INSTRUMENTED IMPACT TEST
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GR/BMI #7

Drop weight = 7.00Lb Data disk MAT01204
 Tup radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 6.67ft/s abs(V_f) = 5.85ft/s
 K.E. = 4.83ft-Lb V_f (calc) = -4.85ft/s

Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)
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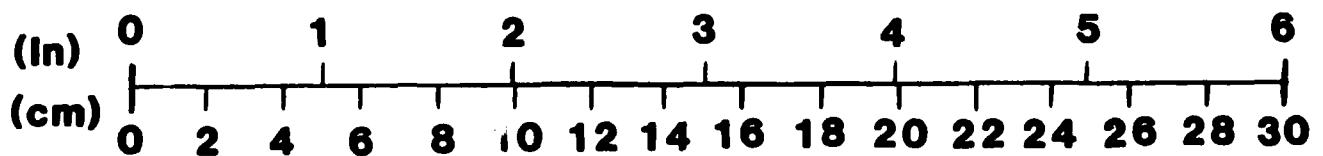
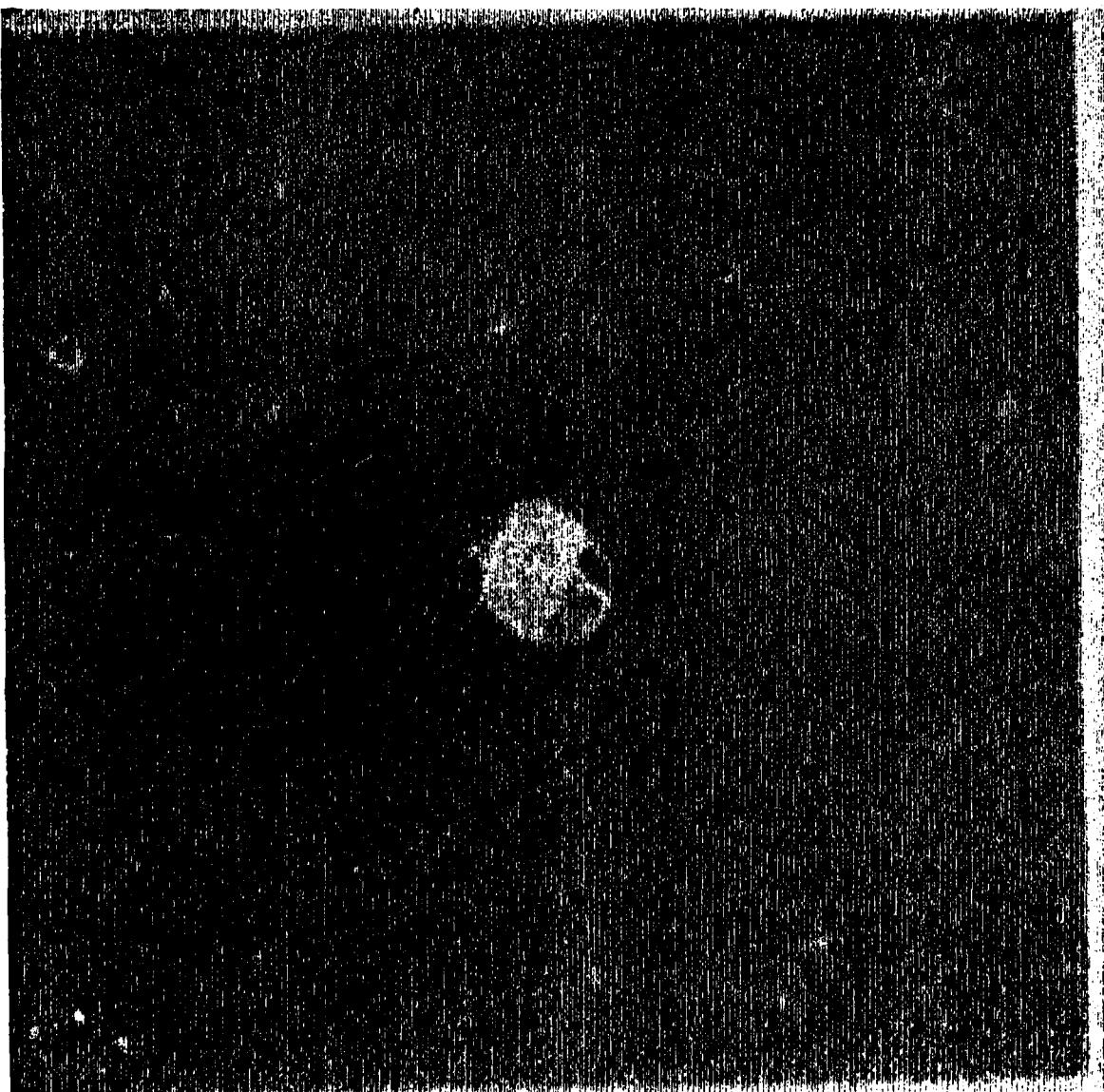
519.8	2.195E-3	2.82	.1581	Initial damage
680.7	3.525E-3	4.88	.2010	Maximum force
667.2	3.775E-3	4.95	.2022	Maximum energy
667.2	3.775E-3	4.95	.2022	Maximum displacement
8.1	7.205E-3	2.31	.0635	Final values



NADC-85023-60

GR/BMI 5245C

#7

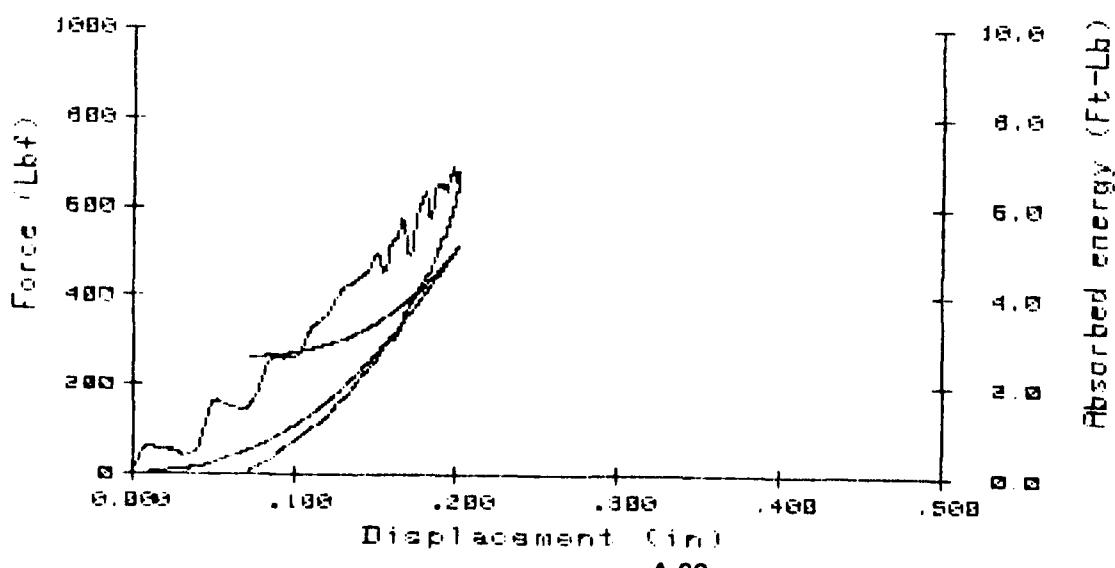
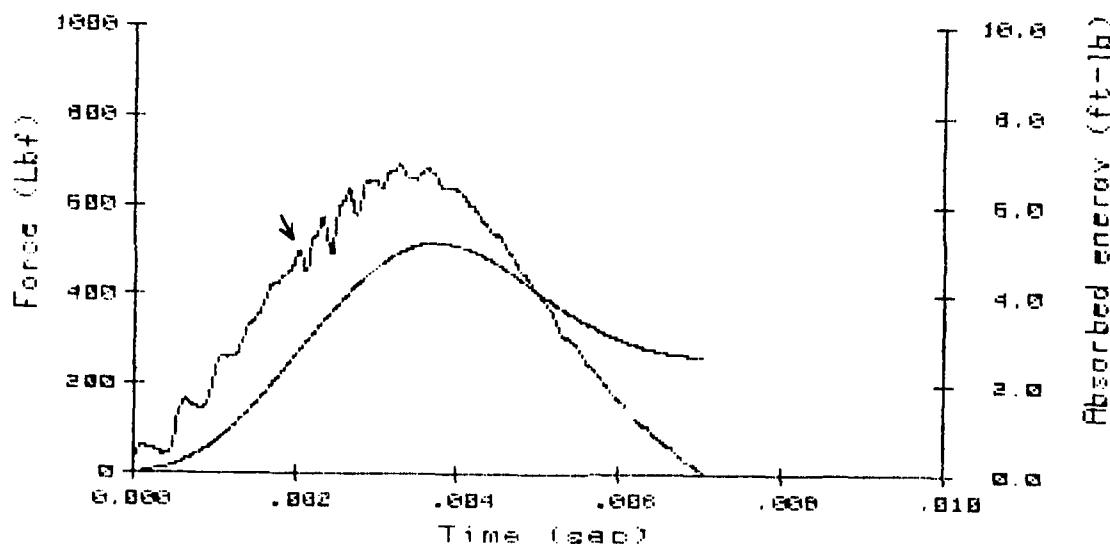


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INSTRUMENTED IMPACT TEST
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GR/BMI #8

Drop weight =	7.00Lb	Data disk =	MAT01205
Tup radius =	.500in	DRM scale	.4Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V_0 =	6.80ft/s	$\text{abs}(V_f) =$	5.95ft/s
K.E. =	5.03ft-Lb	$V_f(\text{calc}) =$	-4.73ft/s

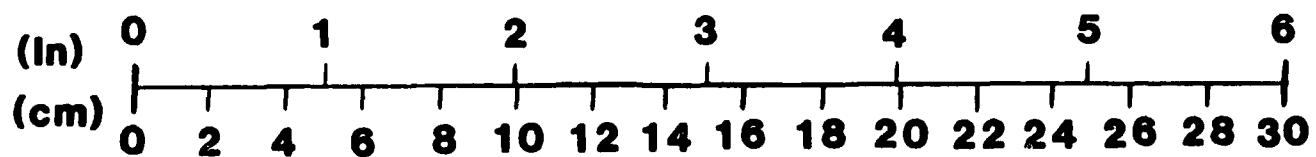
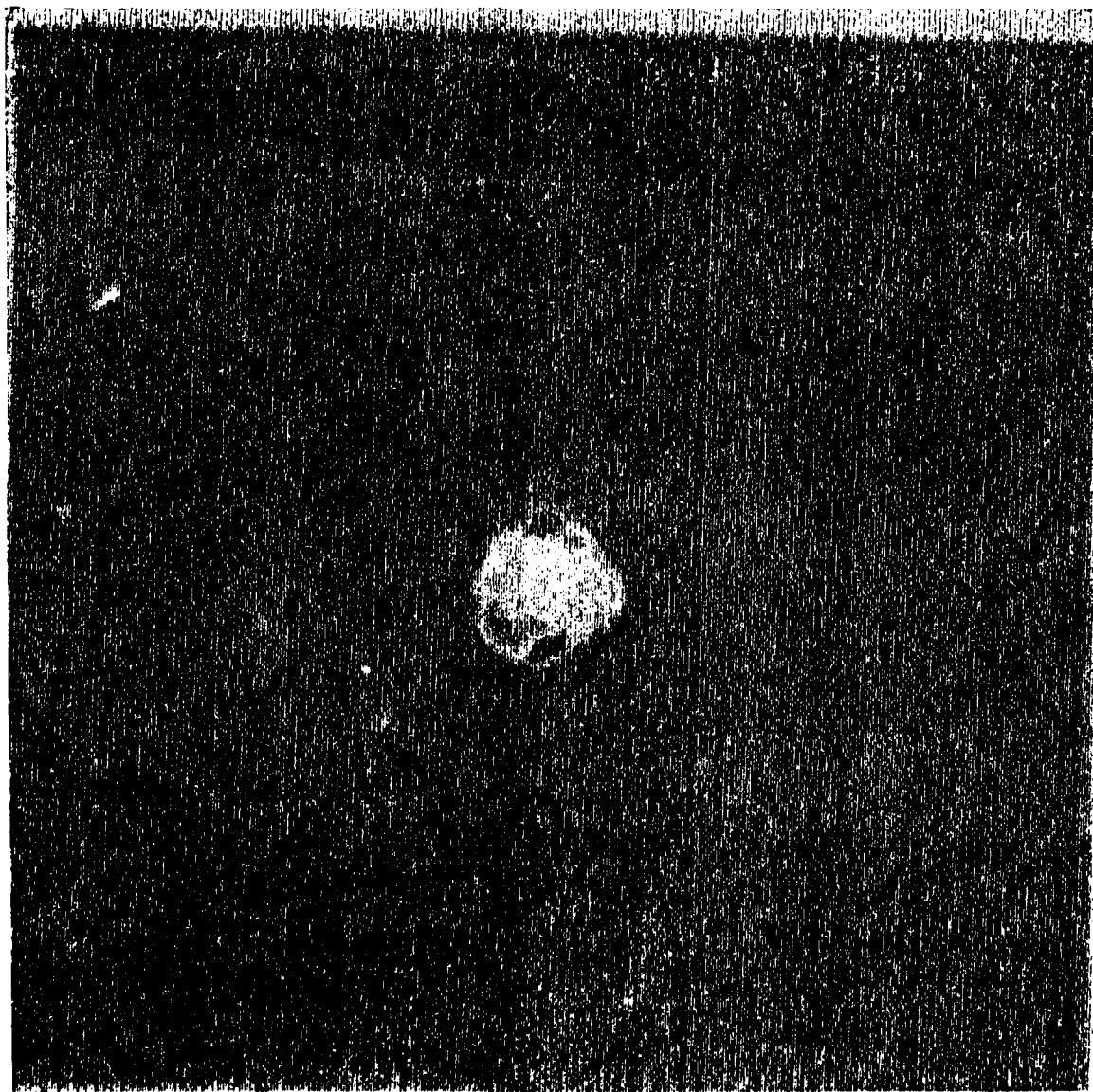
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
500.0	2.035E-3	2.73	.1509	Initial damage
689.7	3.275E-3	4.94	.1975	Maximum force
666.3	3.725E-3	5.15	.2012	Maximum energy
666.3	3.725E-3	5.15	.2012	Maximum displacement
7.2	7.015E-3	2.64	.0723	Final values



NADC-85023-60

GR/BMI 5245C

#8



NADC-85023-60

NADC/ETI-B200 DROP TEST FACILITY

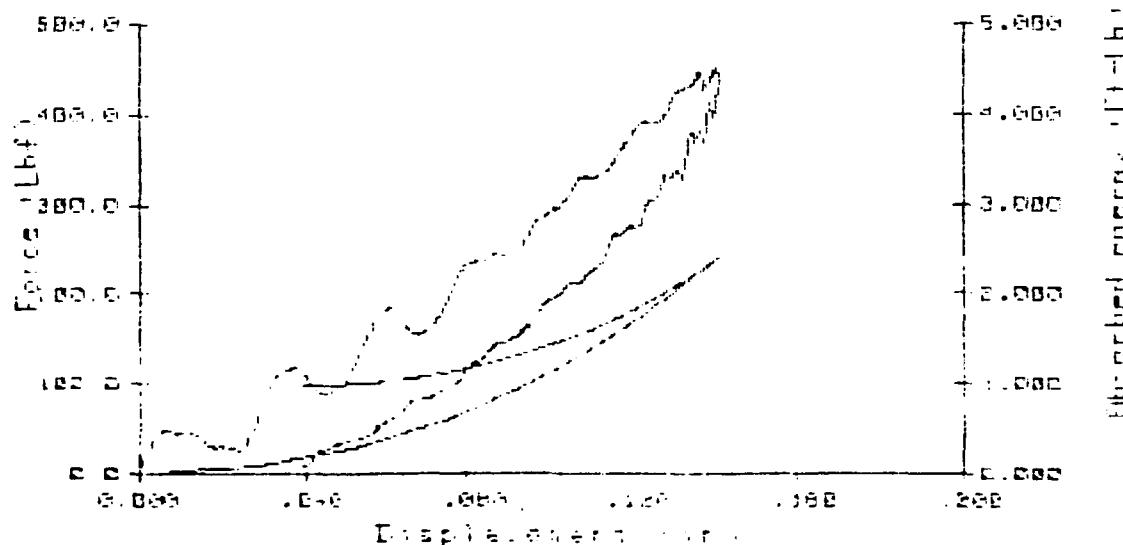
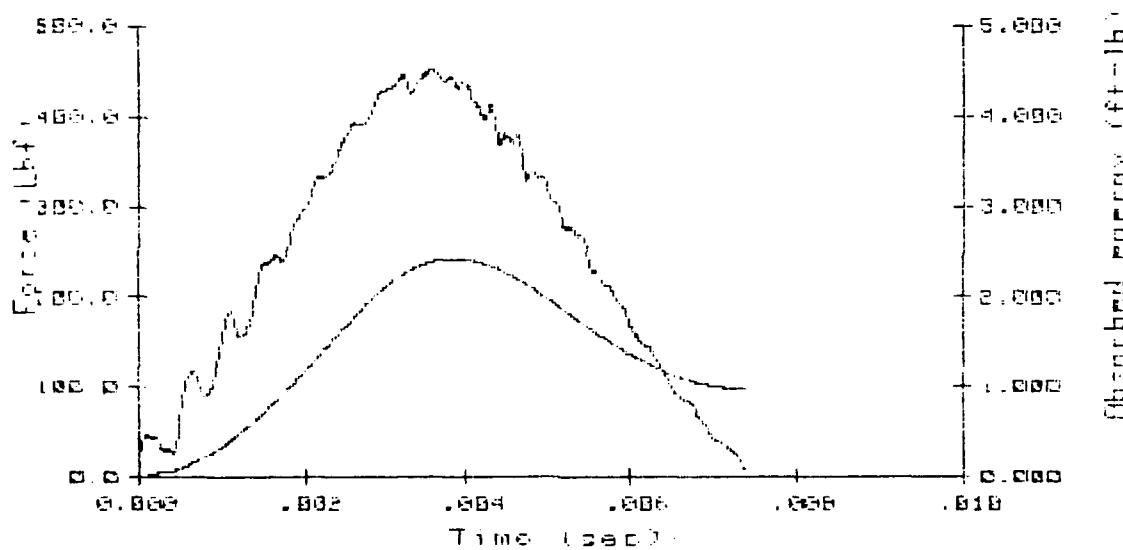
6/21/84

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INSTRUMENTED IMPACT TEST
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GR/EMI #9

Drop weight = 7.00Lb Data disk MAT01206
 Tup radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid = .040in
 V_0 = 4.63ft/s abs(Vf) = 4.22ft/s
 R.E. = 2.33ft-Lb Vf(calc) = -3.56ft/s

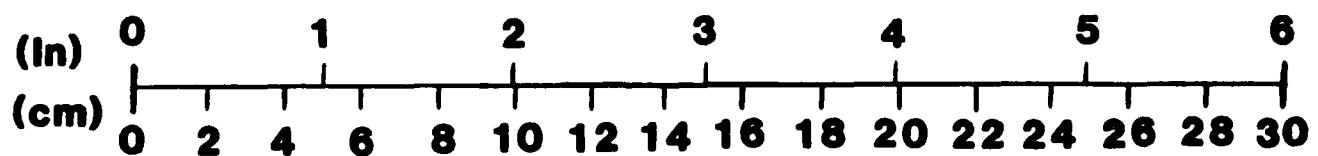
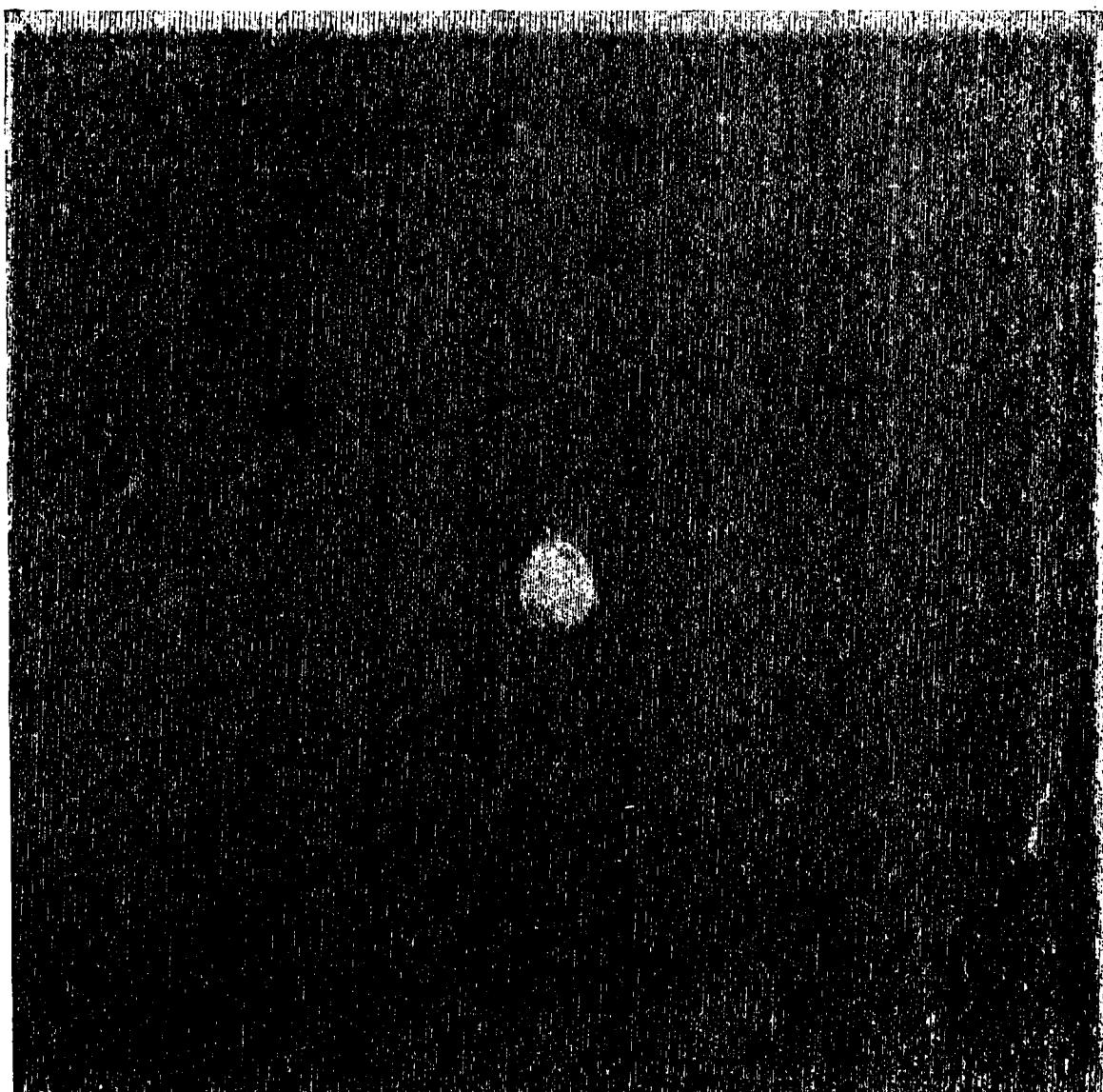
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
453.2	3.575E-3	.238	.1406	Maximum force
457.9	3.855E-3	2.41	.1415	Maximum energy
457.9	3.855E-3	2.41	.1415	Maximum displacement
8.1	7.385E-3	.97	.0398	Final values



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GR/BMI 5245C

#9



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

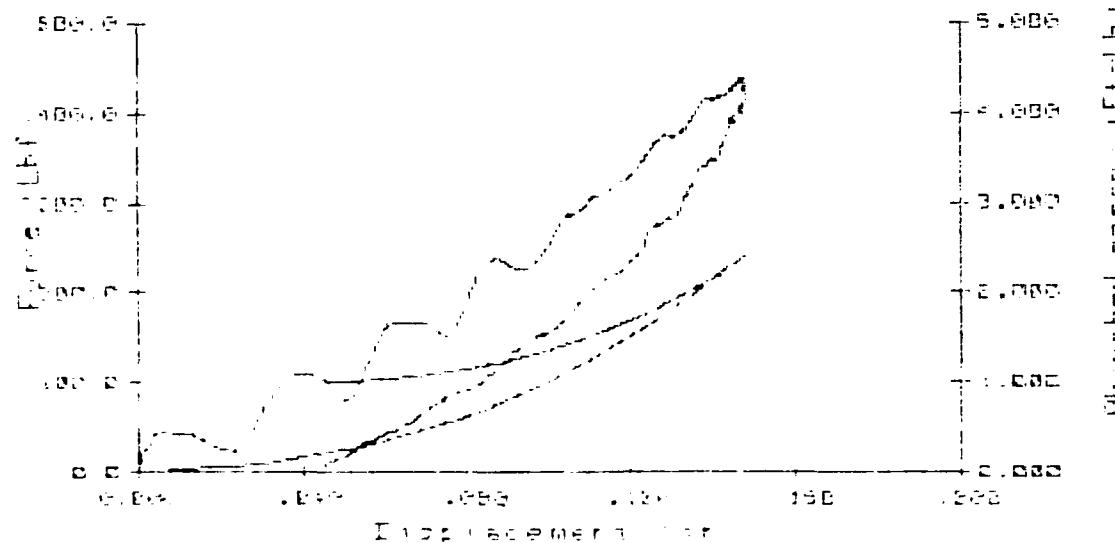
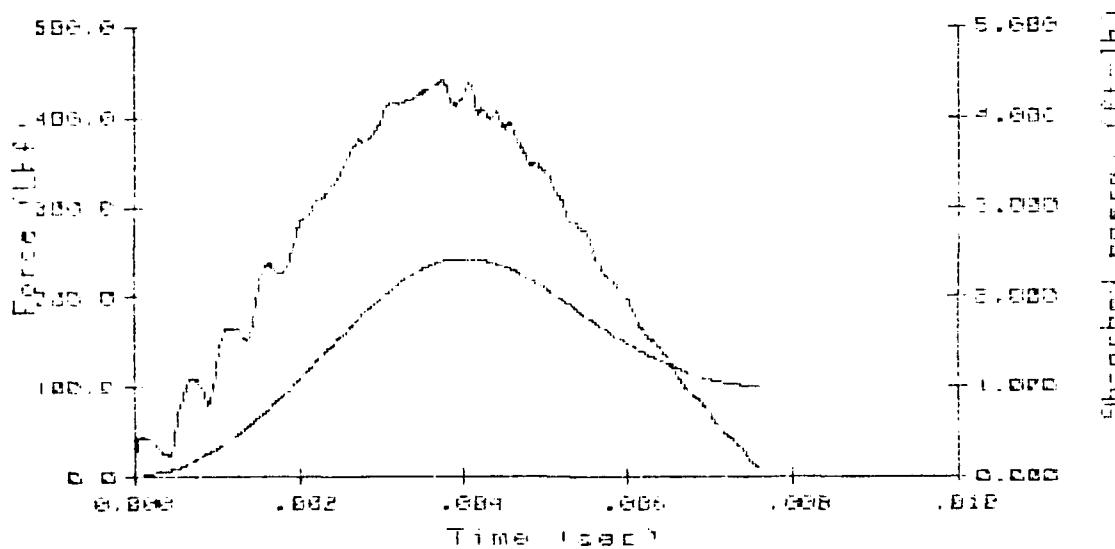
6/21/84

 INSTRUMENTED IMPACT TEST

GP/BM1 #10

Drop weight = 7.00LB Data disk = MAT01207
 Tup radius = .500in DRM scale = .4Kn/Div
 Temperature = 74.0 F Flag grid = .040in
 V_C = 4.63ft/s abs(Vf) = 4.33ft/s
 I.E. = 2.33ft-Lb Vf(calc) = -3.52ft/s

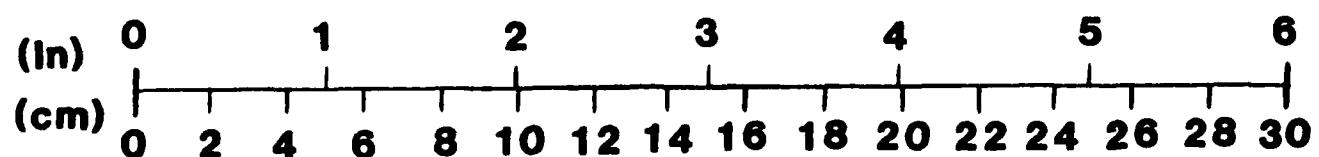
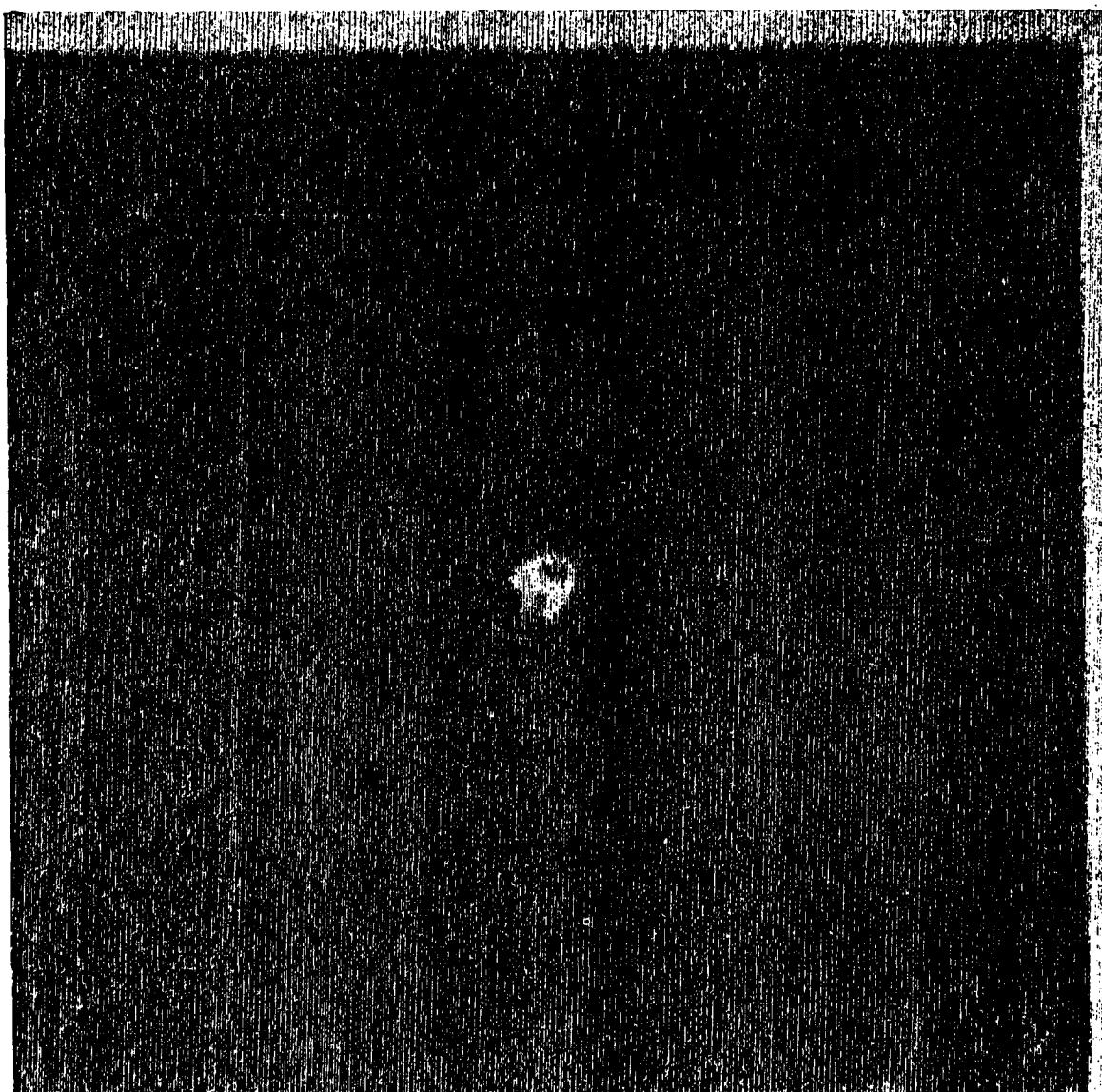
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
440.6	3.745E-3	2.39	.1472	Maximum force
472.5	4.025E-3	2.42	.1481	Maximum energy
402.5	4.025E-3	2.42	.1481	Maximum displacement
7.2	7.615E-3	1.01	.0454	Final values



NADC-85023-60

GR/BMI 5245C

#10



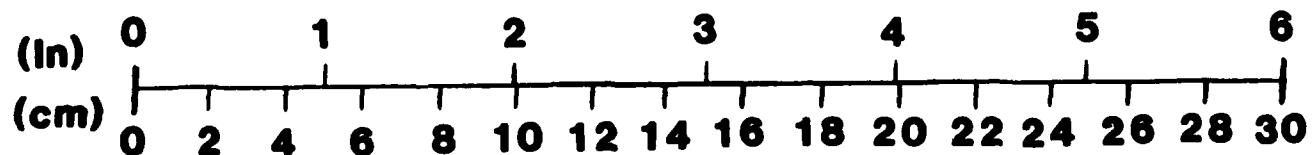
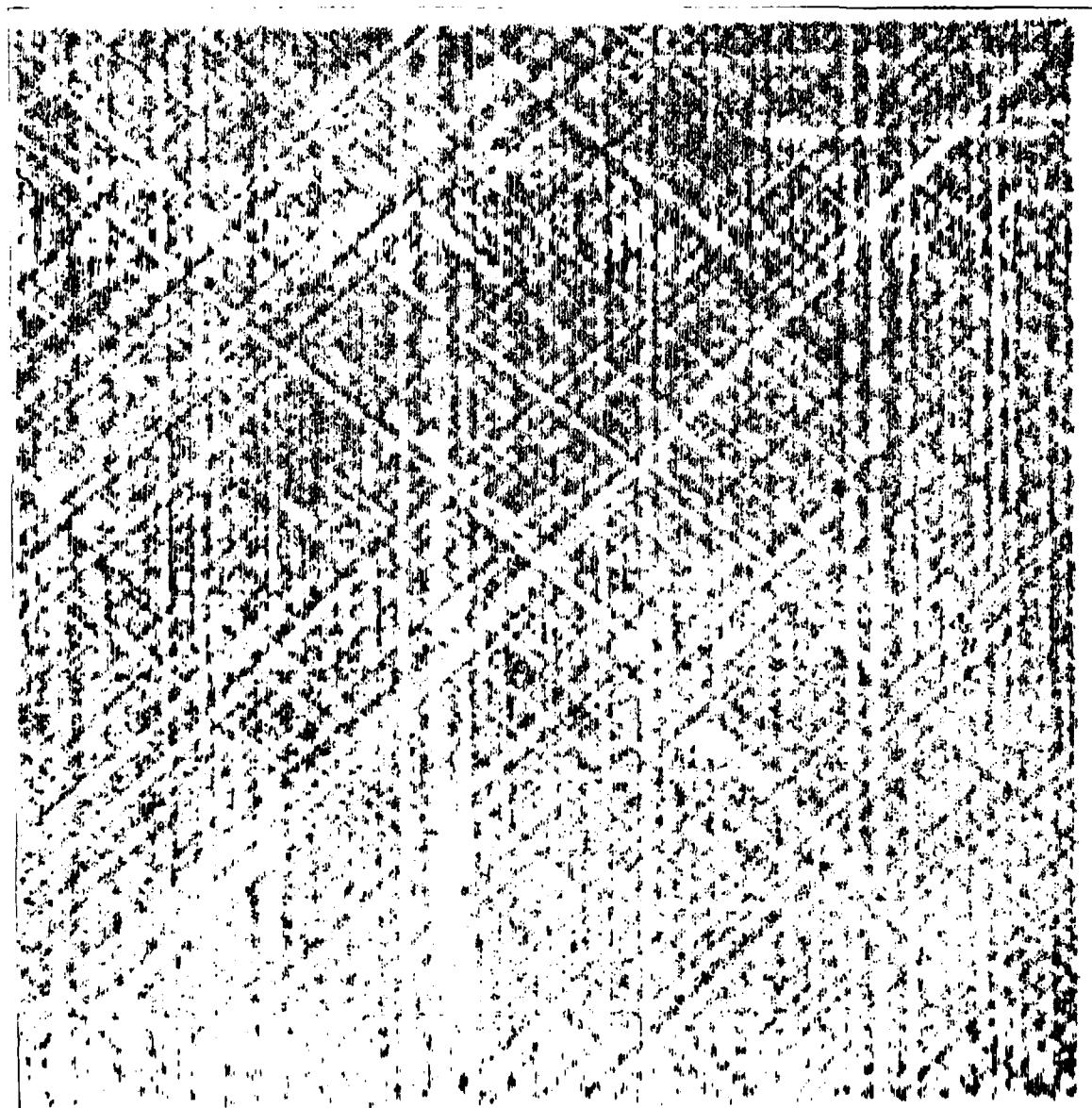
NADC-85023-60

T300/81-5

NADC-85023-60

81-5 GR/BMI

#12



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

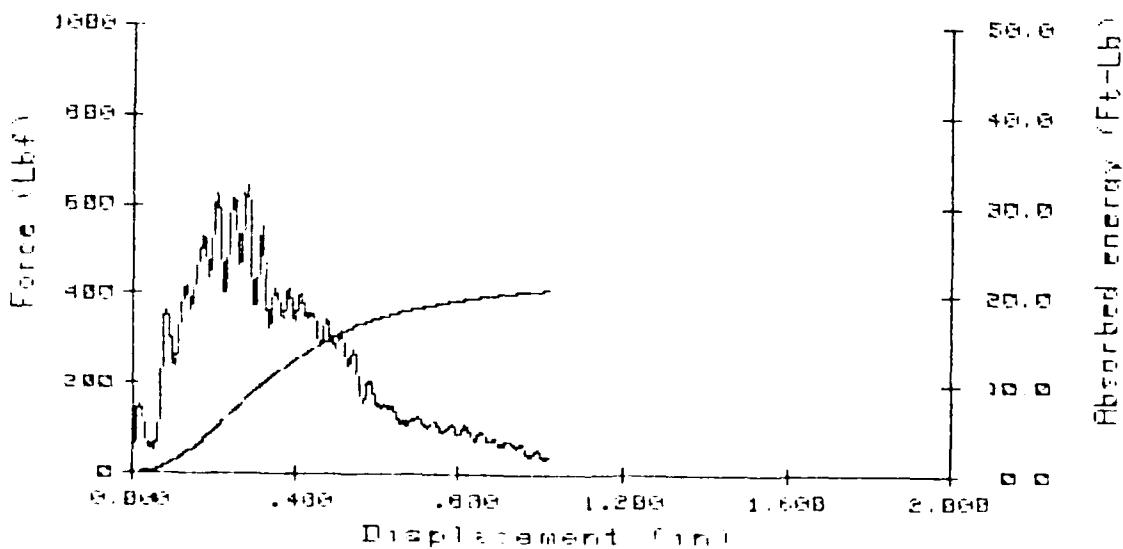
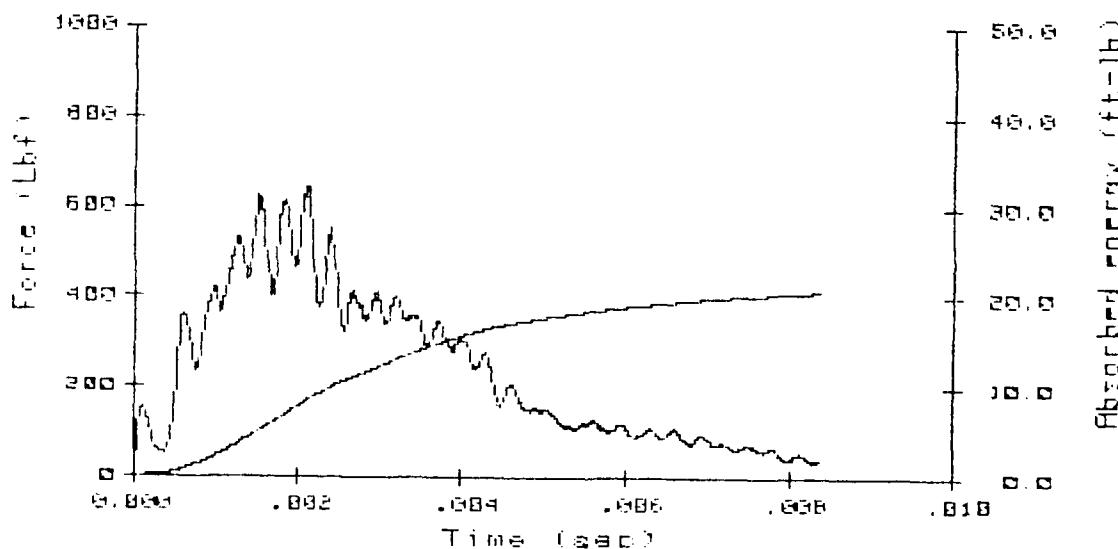
1/17/84

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INSTRUMENTED IMPACT TEST
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B1-5 GR/BMI #1

Drop weight = 31.36Lb Data disk MAT00702
Tup radius = .500in DRM scale .4Kn/Div
Temperature = 74.0 F Flag grid= .040in
VO = 11.30ft/s
E.E. = 62.17ft-Lb Vf(calc) = 9.53ft/s

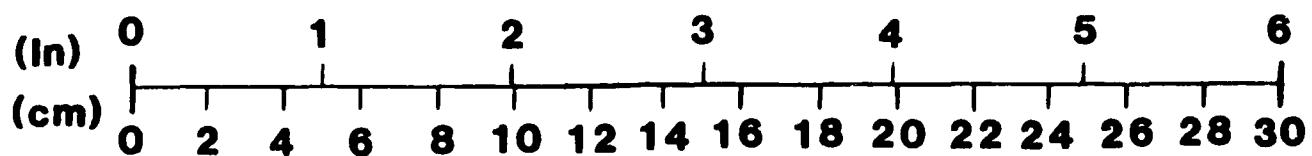
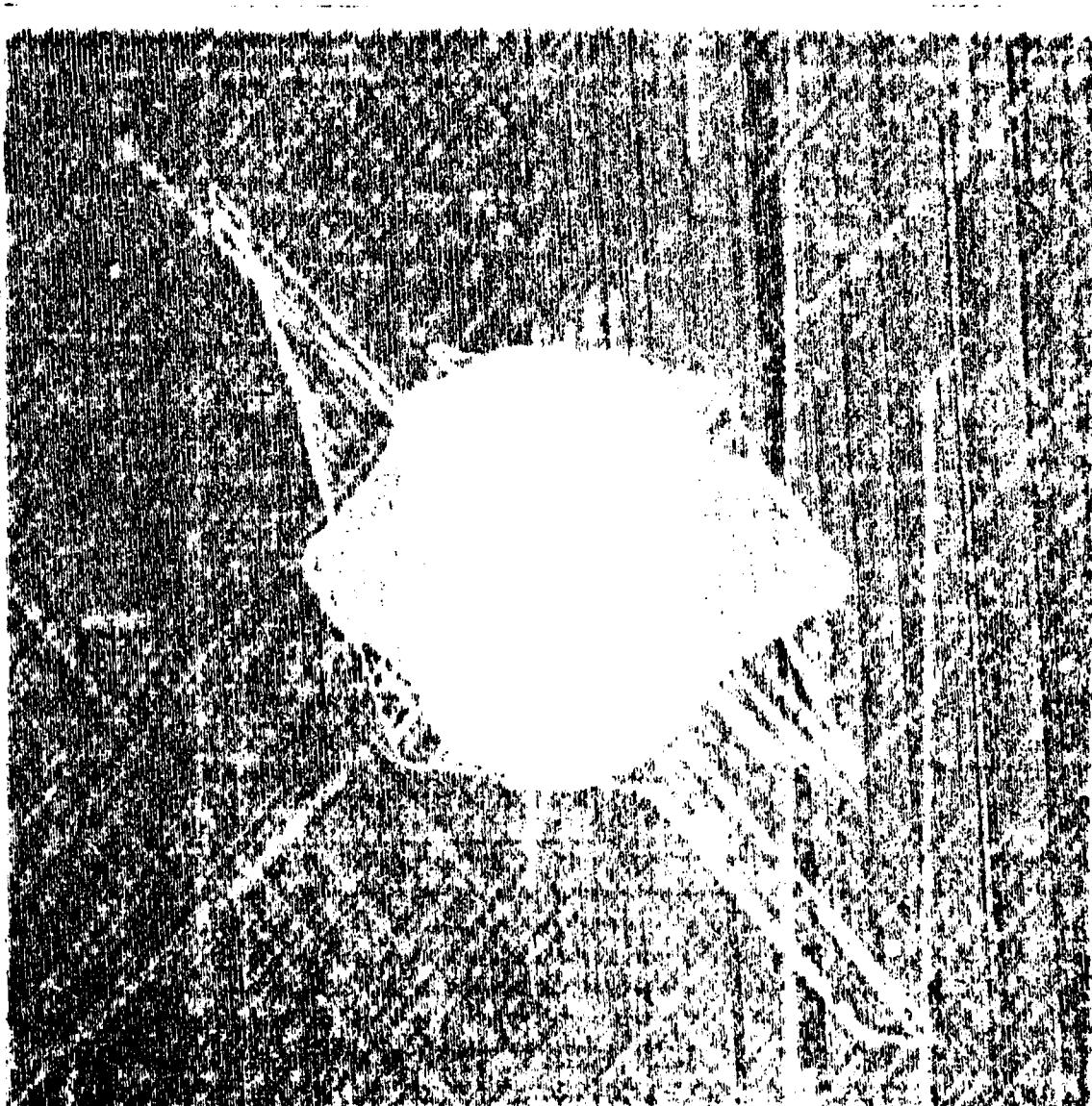
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
643.9	2.147E-3	8.63	.2853	Maximum force
37.8	8.378E-3	20.58	1.0191	Maximum energy
37.8	8.378E-3	20.58	1.0191	Maximum displacement
37.8	8.378E-3	20.58	1.0191	Final values



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81-5 GR/BMI

#1



RD-A160 953

IMPACT CHARACTERIZATION OF NEW COMPOSITE MATERIALS(U)
NAVAL AIR DEVELOPMENT CENTER WARMINSTER PA AIRCRAFT AND
CREW SYSTEMS TECHNOLOGY DIRECTORATE L W GAUSE ET AL.

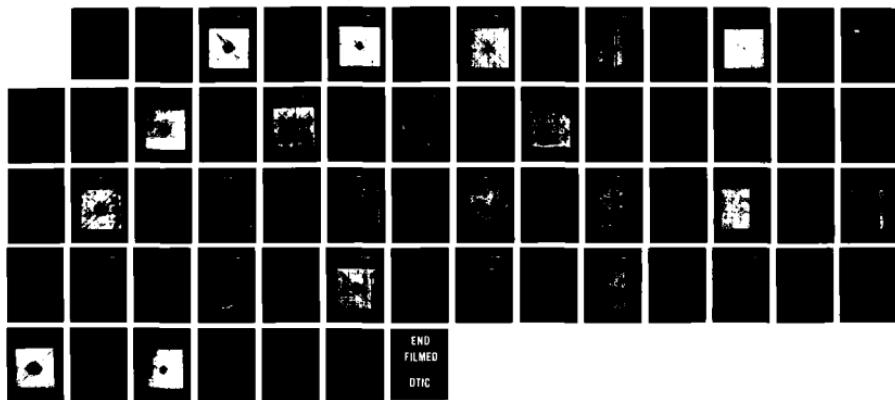
2/2

UNCLASSIFIED

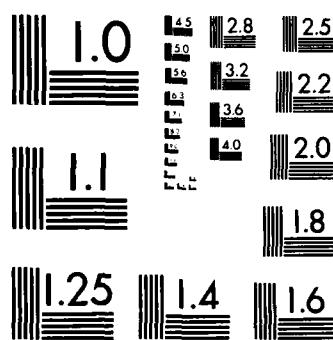
FEB 85 NADC-85023-50

F/G 11/4

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END
FILMED
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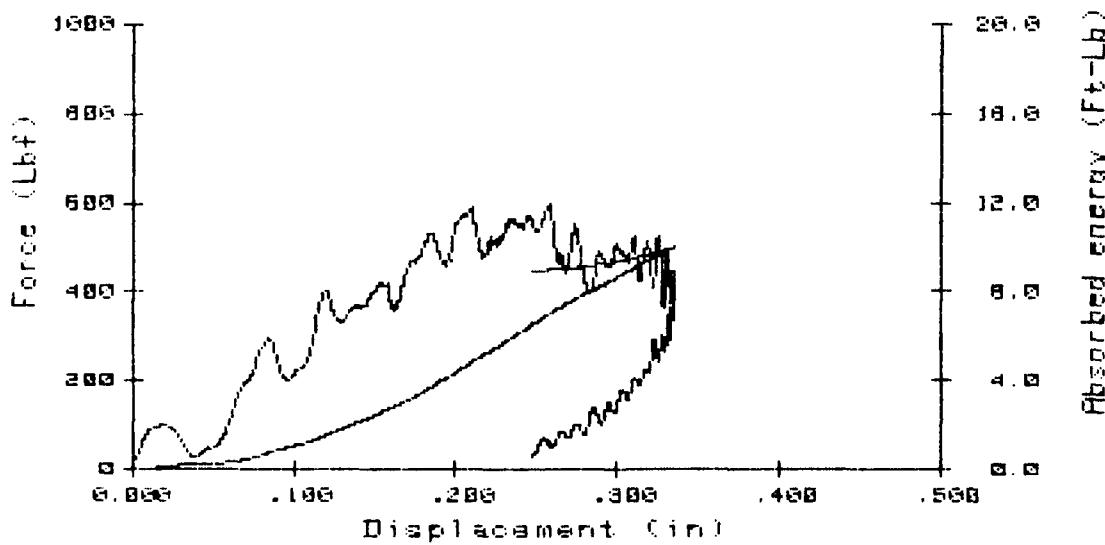
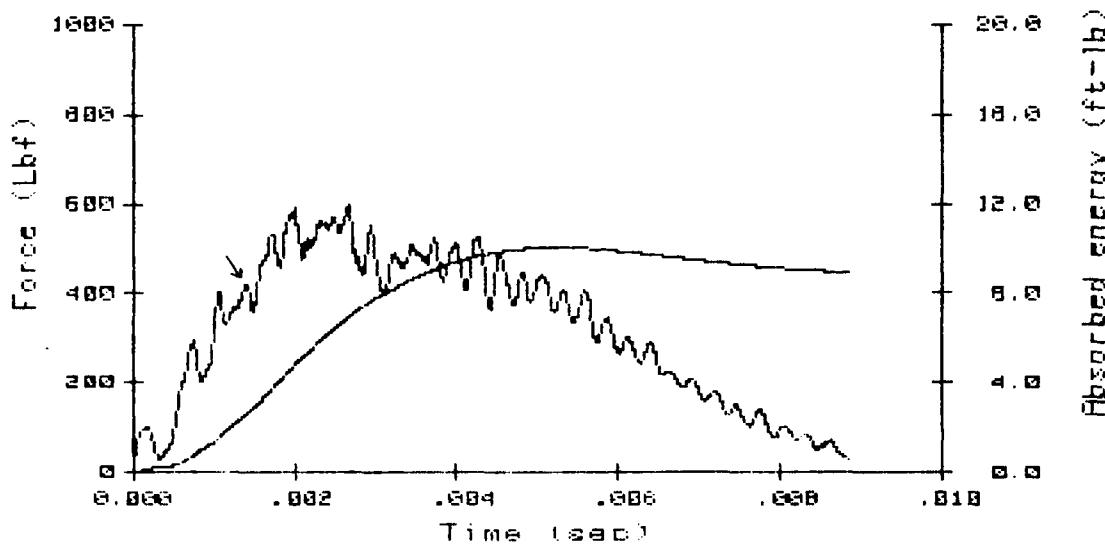
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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INSTRUMENTED IMPACT TEST
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1-5 GR/BMI #2

Drop weight = 7.00LB Data disk MAT00704
 Tip radius = .500ip DRM scale 4Kn/Div
 Temperature = 74.0°F Flag grid = .040in
 V_0 = 9.52ft/s
 K.E. = 9.86ft-Lb V_f (calc) = -3.11ft/s

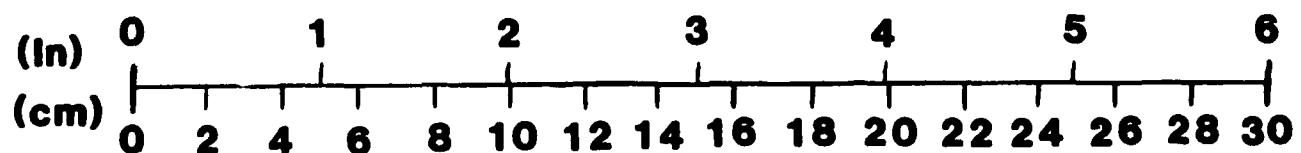
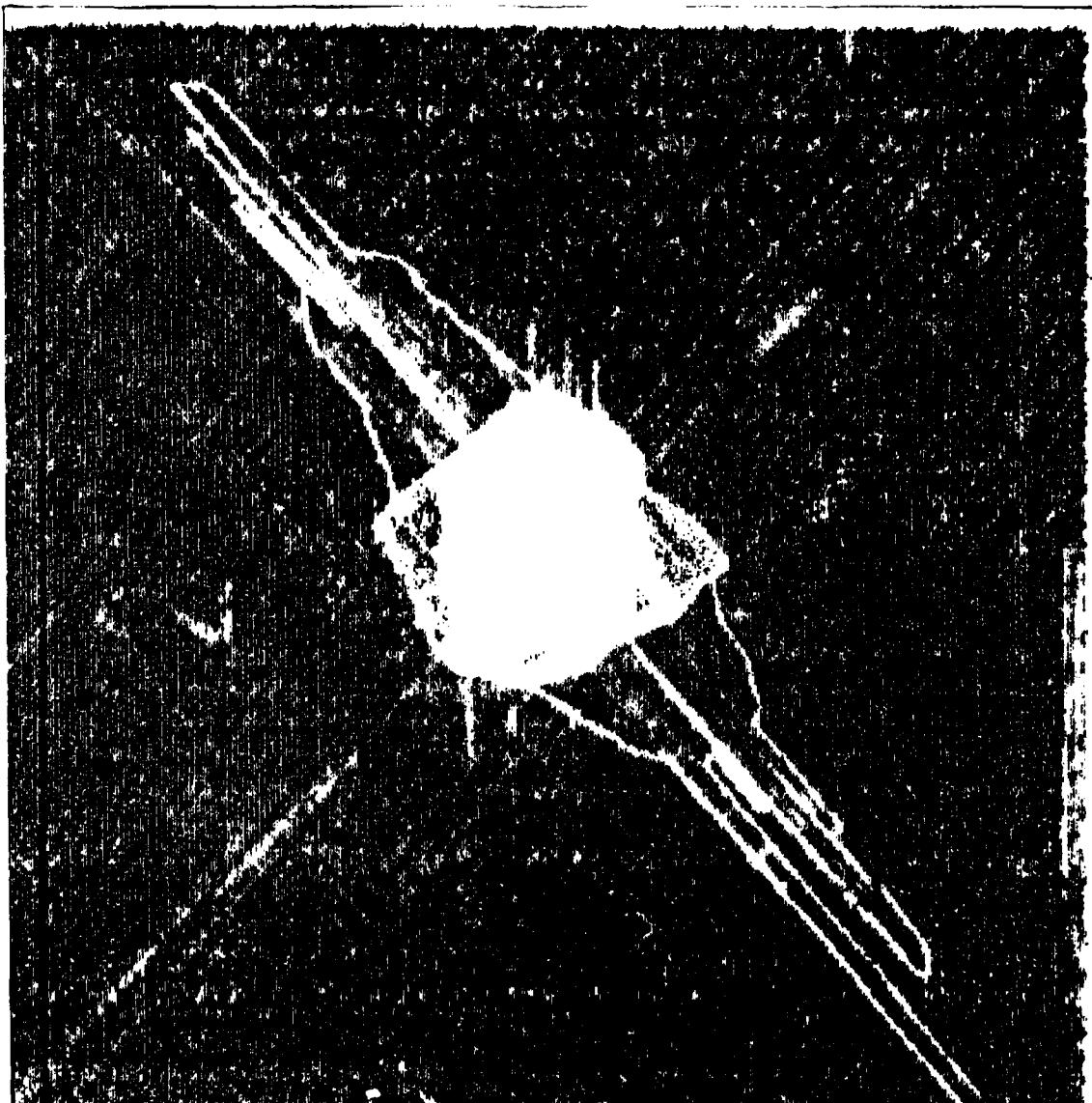
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
419.9	1.393E-03	2.56	.1530	Initial damage
597.1	2.678E-03	7.01	.2582	Maximum force
362.4	4.004E-03	10.05	.3357	Maximum energy
362.4	4.230E-03	10.05	.3357	Maximum displacement
31.5	8.838E-03	8.95	.2466	Final values



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81-5 GR/BMI

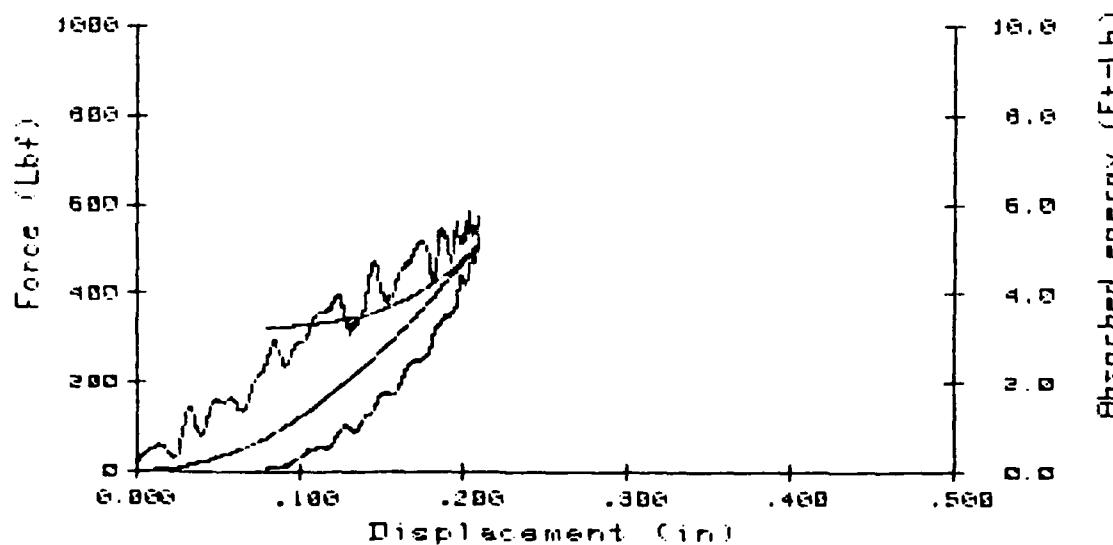
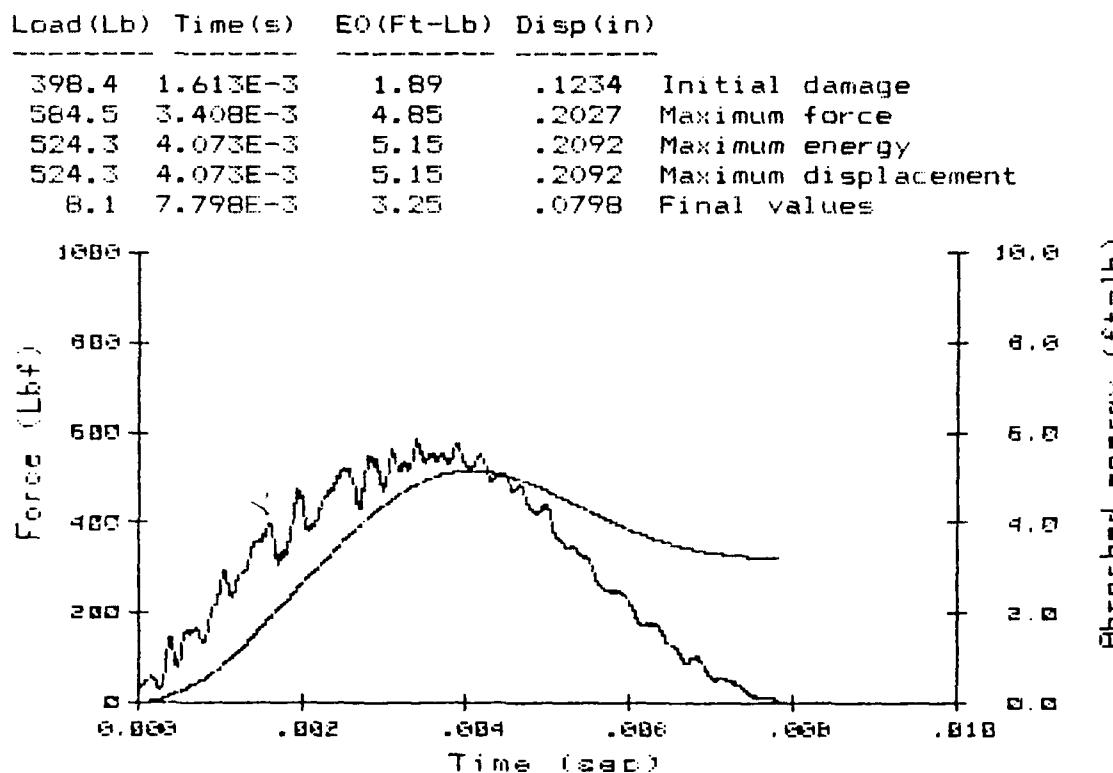
#2



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INSTRUMENTED IMPACT TEST
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81-5 GR/BMI #3

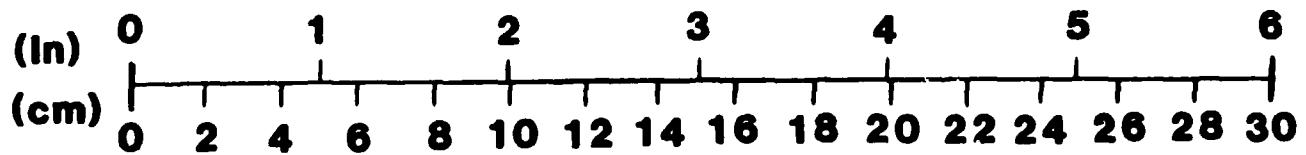
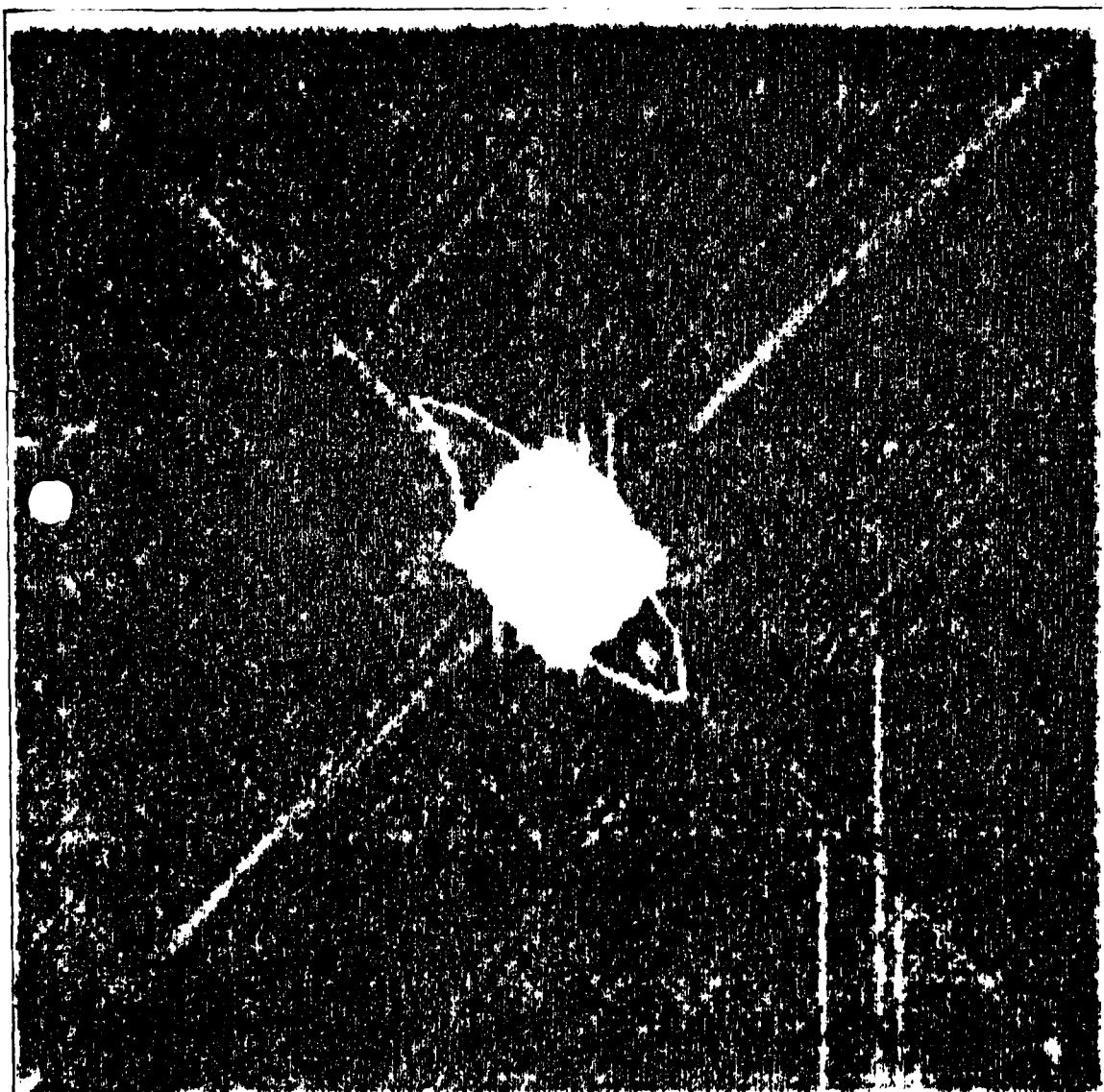
Drop weight = 7.00Lb Data disk MAT00706
 Tup radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 VO = 6.80ft/s abs(Vf) = 5.25ft/s
 K.E. = 5.03ft-Lb Vf(calc) = -4.10ft/s



NADC-85023-60

81-5 GR/BMI

#3



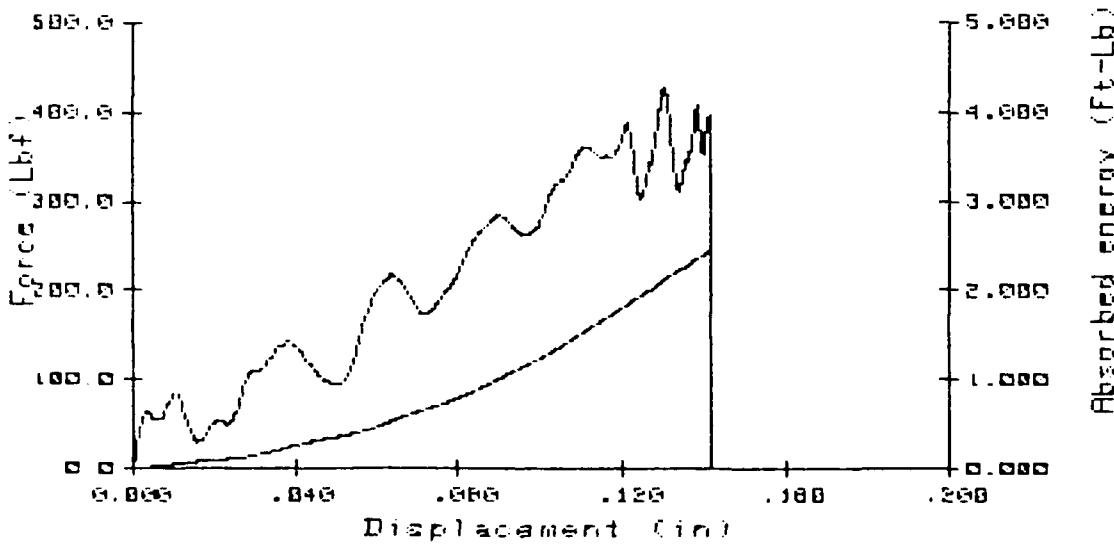
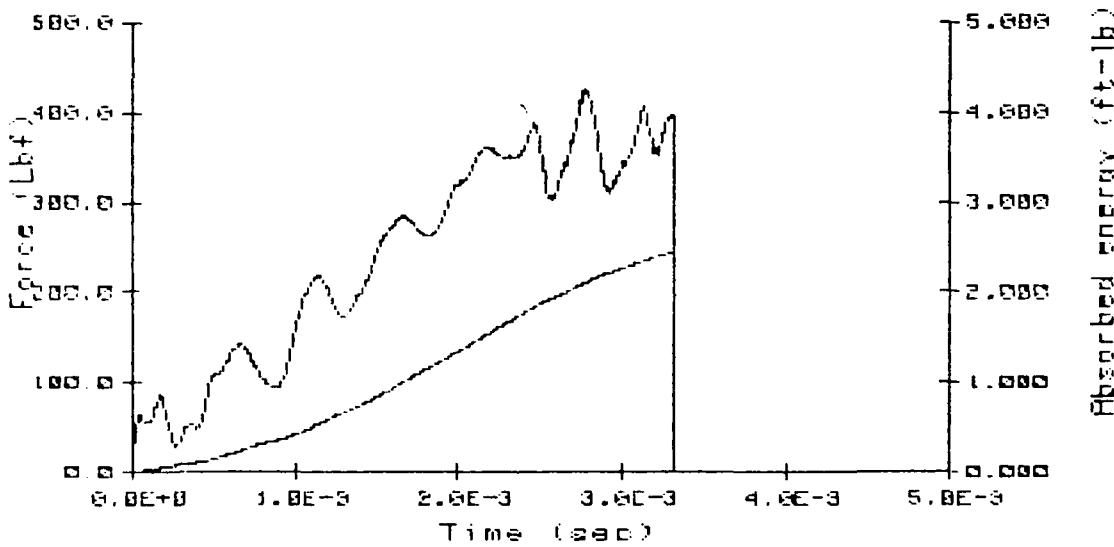
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INSTRUMENTED IMPACT TEST
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81-5 GR/BMI #4

Drop weight = 7.00Lb Data disk MAT00708
 Tup radius = .500in DRM scale .2Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 4.83ft/s
 K.E. = 2.54ft-Lb V_f (calc) = 1.28ft/s

Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)
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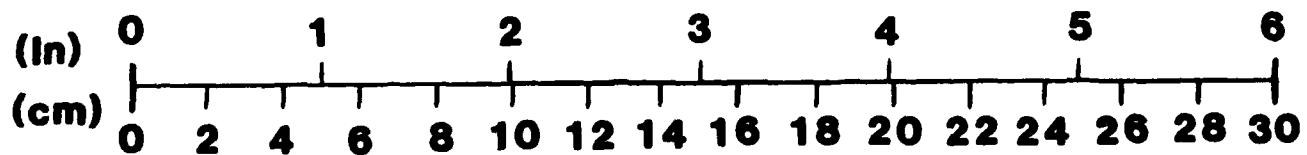
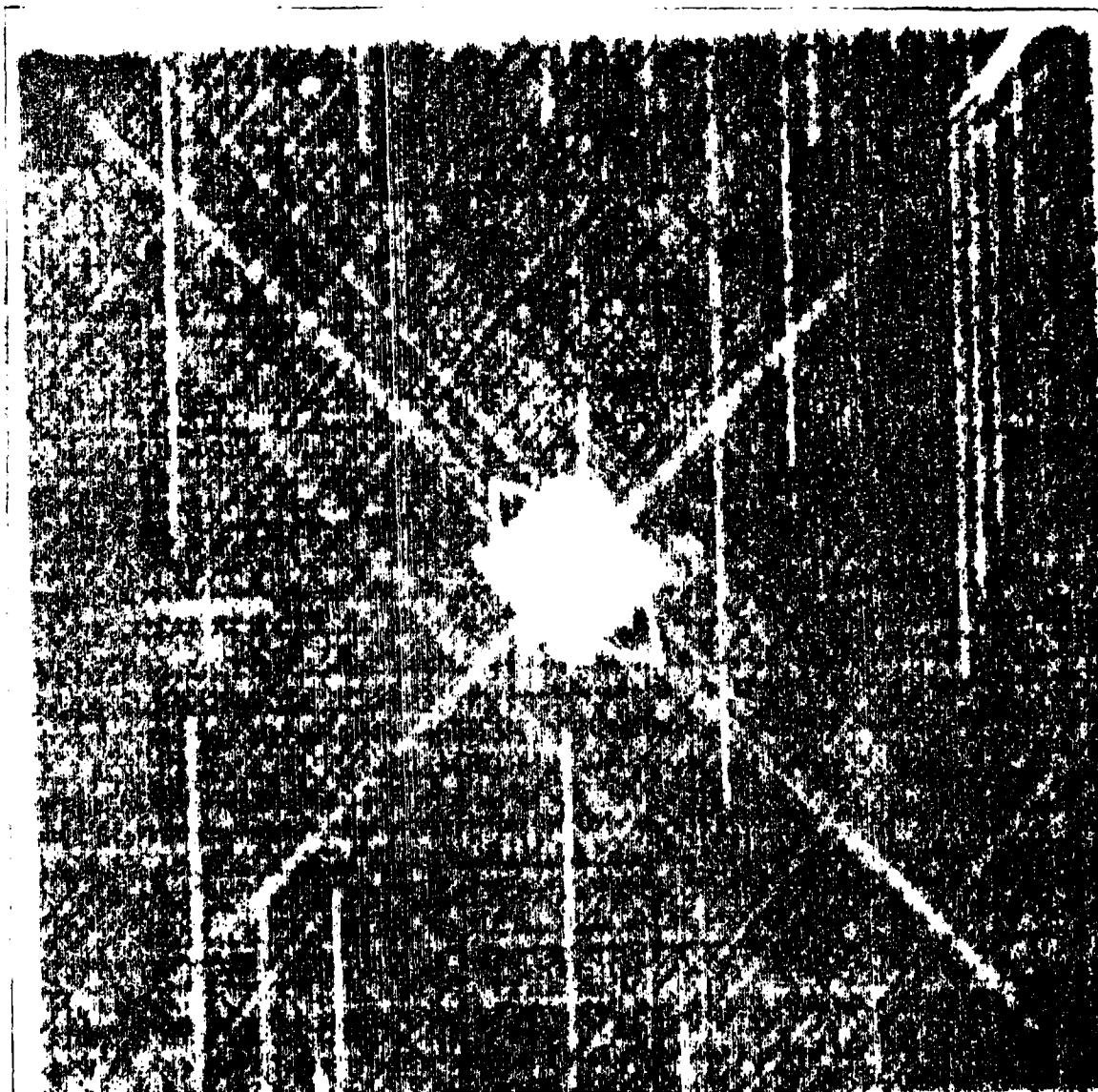
387.6	2.457E-3	1.83	.1210	Initial damage
426.2	2.768E-3	2.10	.1300	Maximum force
393.4	3.313E-3	2.44	.1414	Maximum energy
0.0	3.317E-3	2.44	.1415	Maximum displacement
0.0	3.317E-3	2.44	.1415	Final values



NADC-85023-60

81-5 GR/BMI

#4

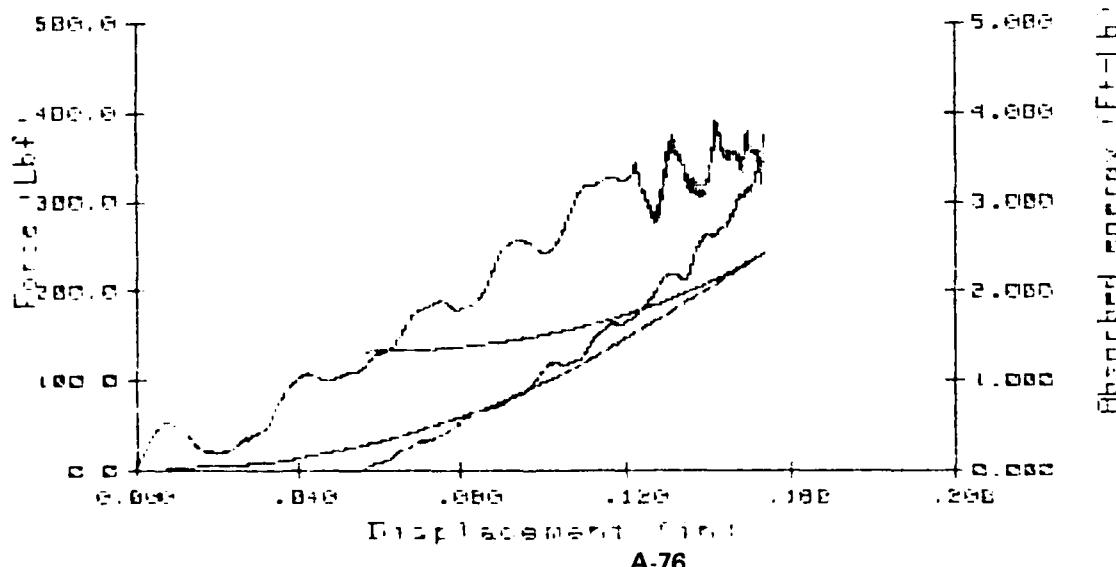
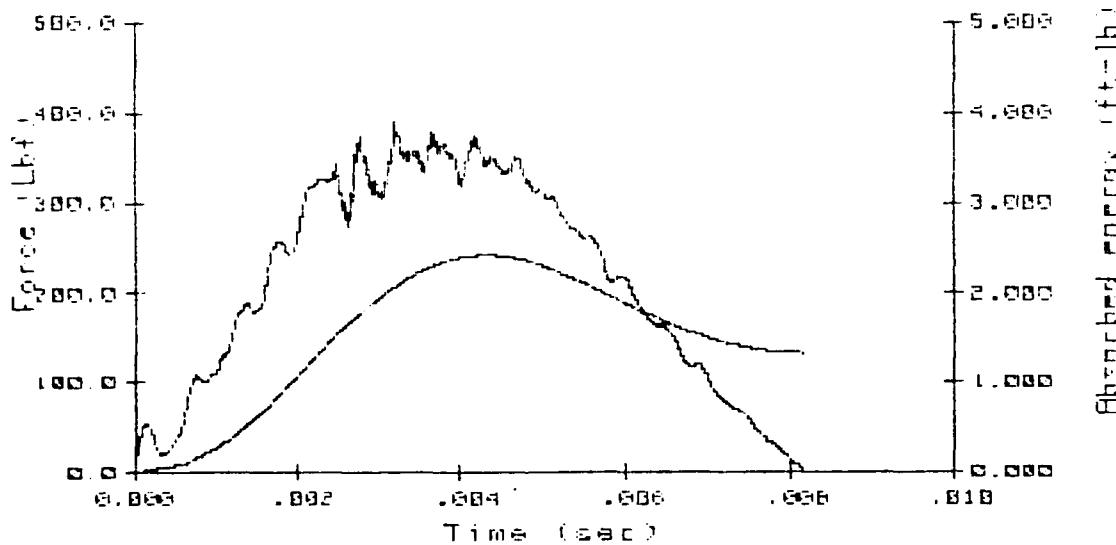


 INSTRUMENTED IMPACT TEST

B1-5 GR/BMI #5

Drop weight = 7.00Lb Data disk MAT00805
 Tup radius = .500in DRM scale .2Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 4.63ft/s
 K.E. = 2.33ft-Lb V_f (calc) = -3.08ft/s

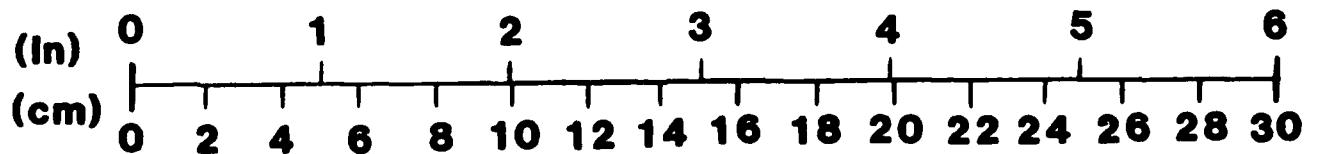
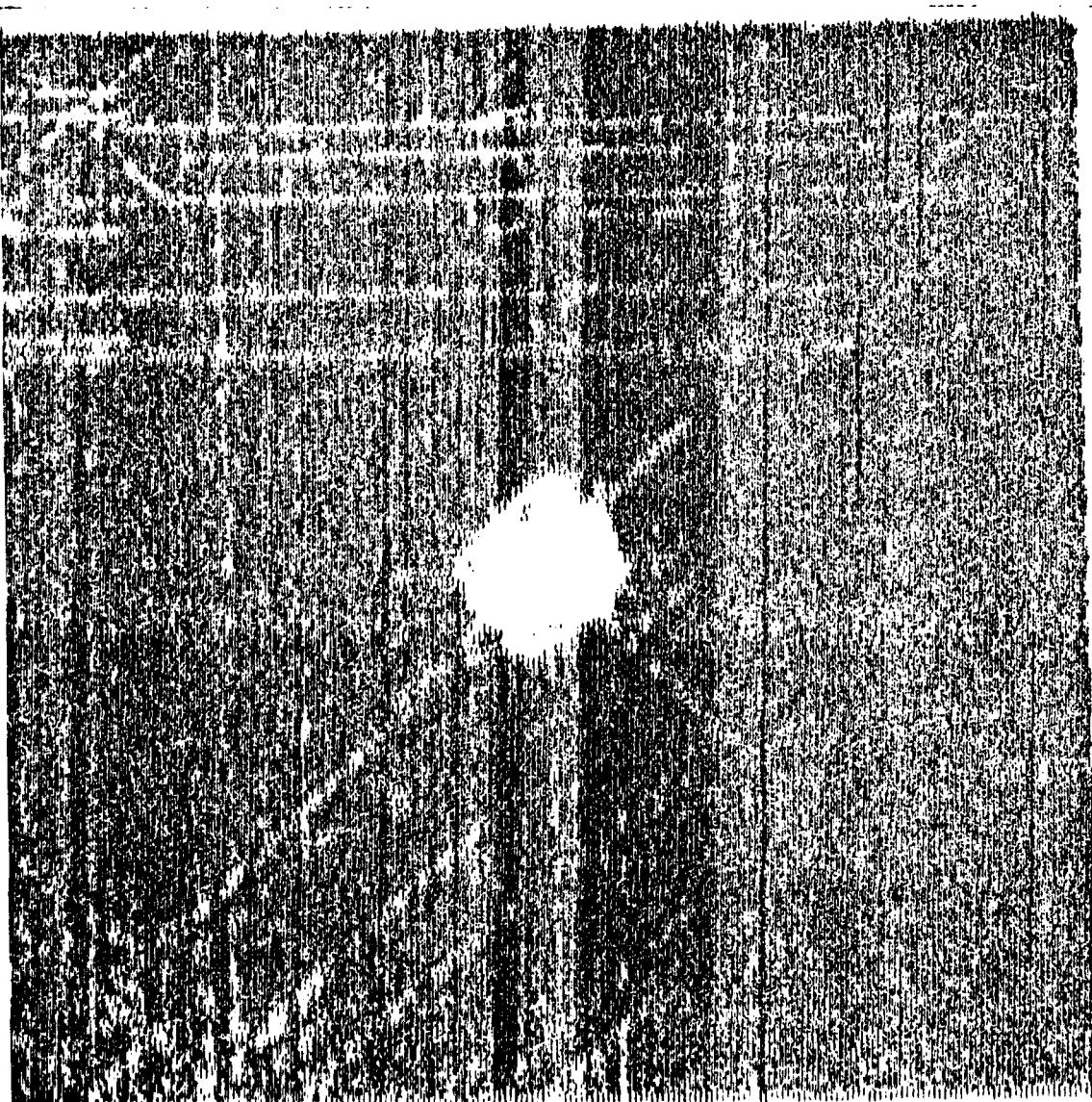
Load (Lb)	Time(s)	E_0 (Ft-Lb)	Disp (in)	
344.0	2.498E-3	1.54	.1220	Initial damage
392.1	3.213E-3	2.07	.1417	Maximum force
344.0	4.318E-3	2.42	.1533	Maximum energy
344.0	4.318E-3	2.42	.1533	Maximum displacement
4.0	8.147E-3	1.33	.0570	Final values



NADC-85023-60

81-5 GR/BMI

#5



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

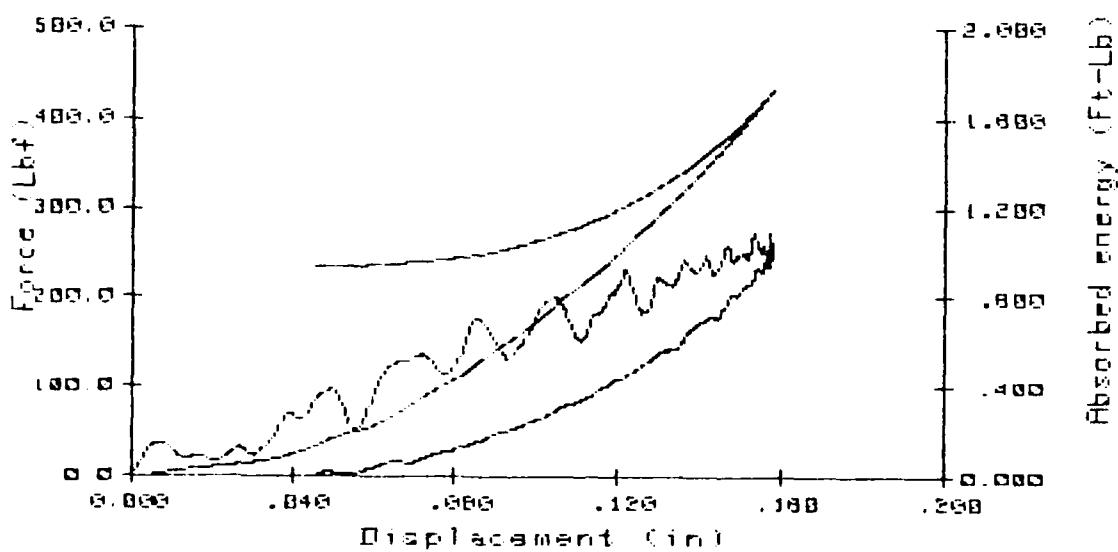
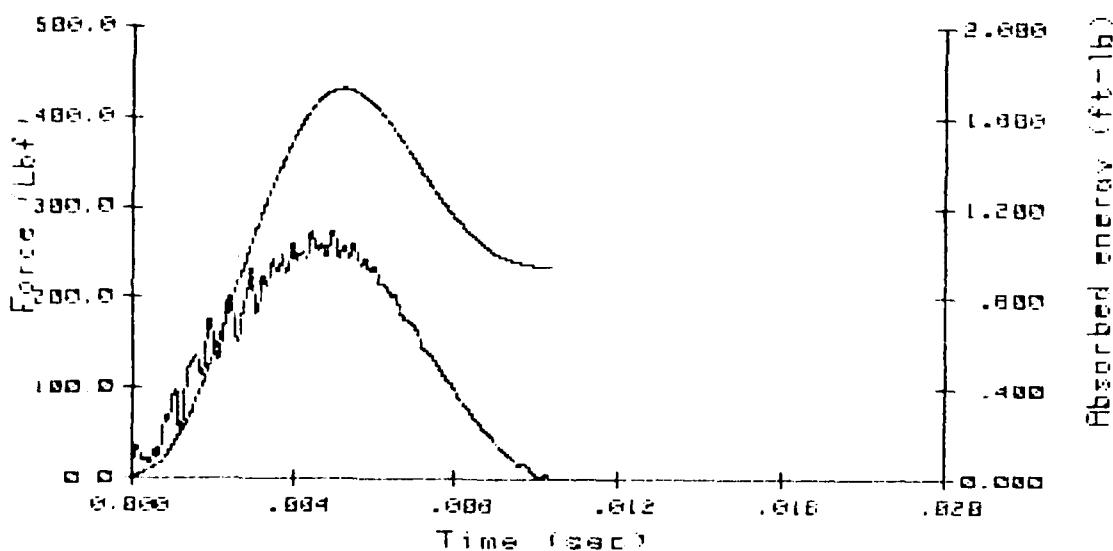
2/17/84

=====
INSTRUMENTED IMPACT TEST
=====

81-5 GR/BMI #7

Drop weight = 7.00Lb Data disk MAT00B08
Tup radius = .500in DRM scale .2Kn/Div
Temperature = 74.0 F Flag grid= .040in
 V_0 = 3.88ft/s abs(V_f) = 3.09ft/s
K.E. = 1.63ft-Lb V_f (calc) = -2.57ft/s

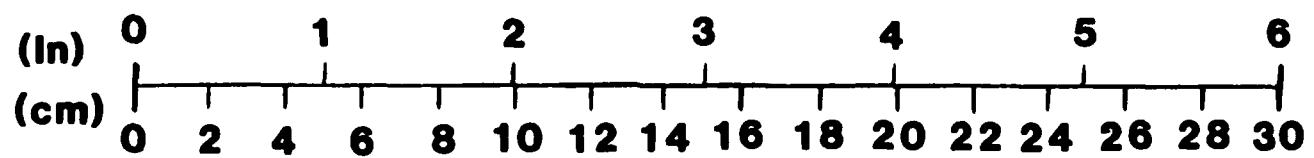
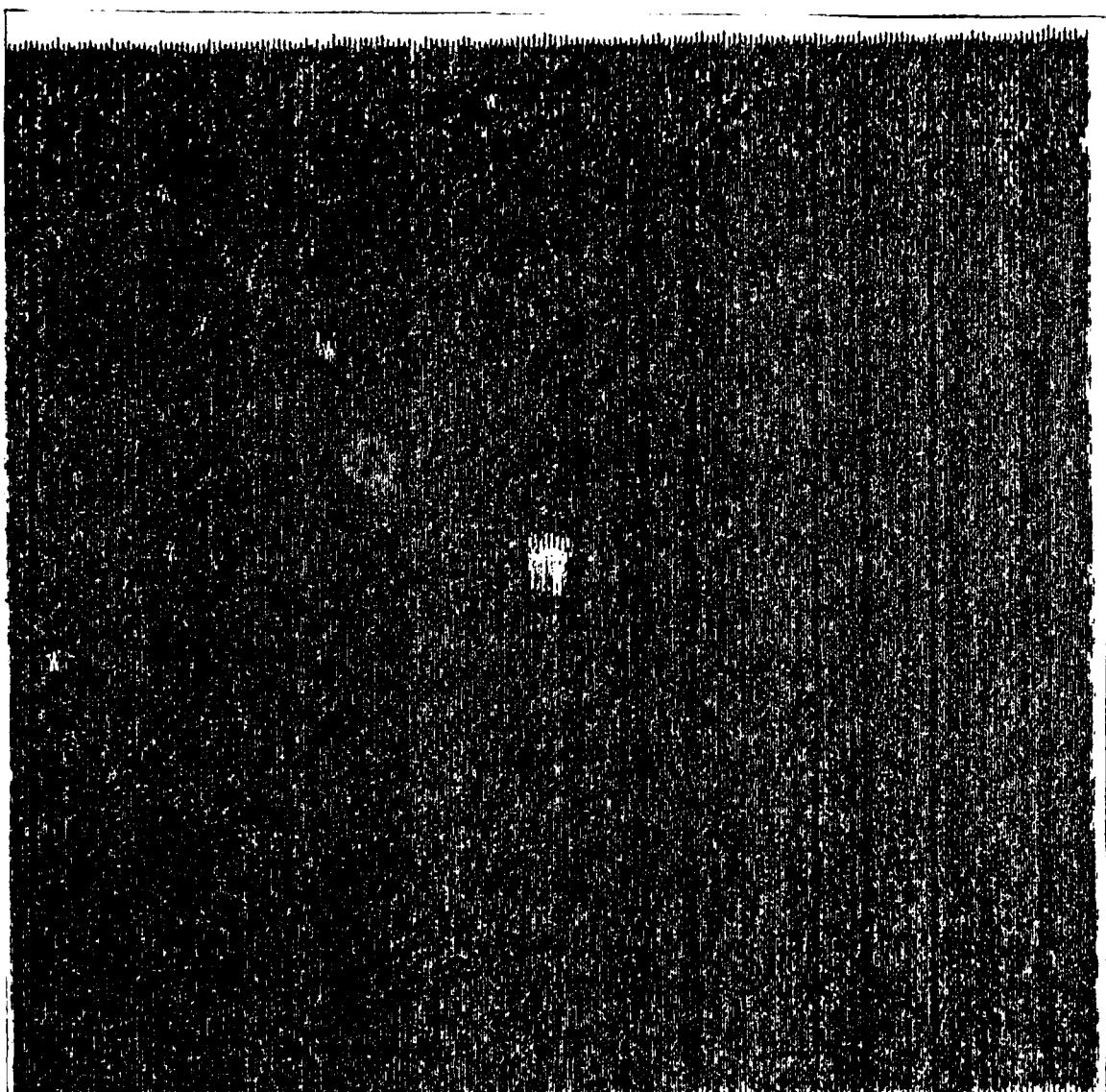
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
231.8	2.945E-3	1.03	.1216	Initial damage
273.9	4.965E-3	1.71	.1571	Maximum force
255.0	5.265E-3	1.72	.1577	Maximum energy
255.0	5.265E-3	1.72	.1577	Maximum displacement
1.3	1.033E-2	.94	.0455	Final values



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81-5 GR/BMI

#7



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

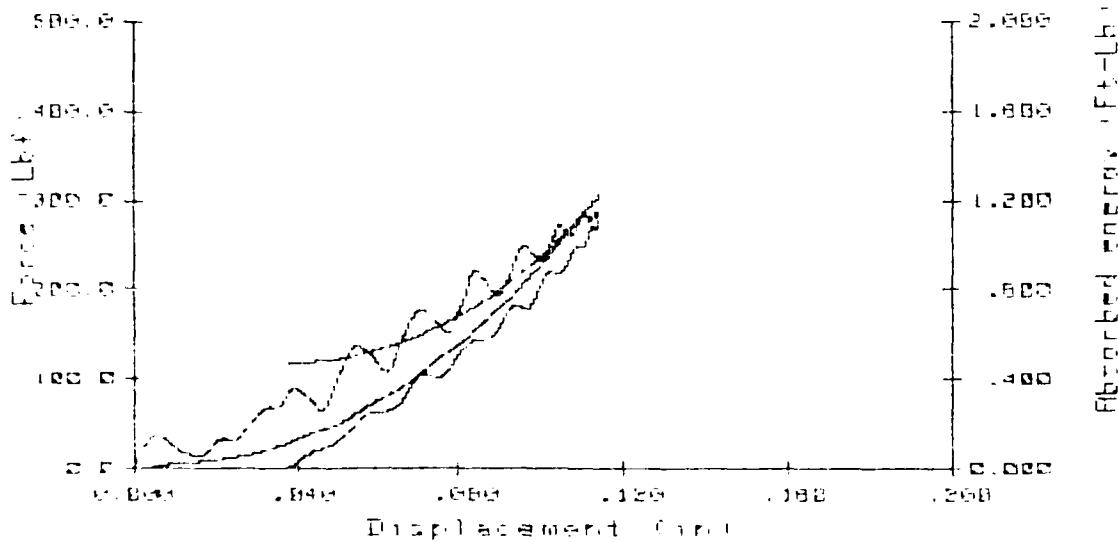
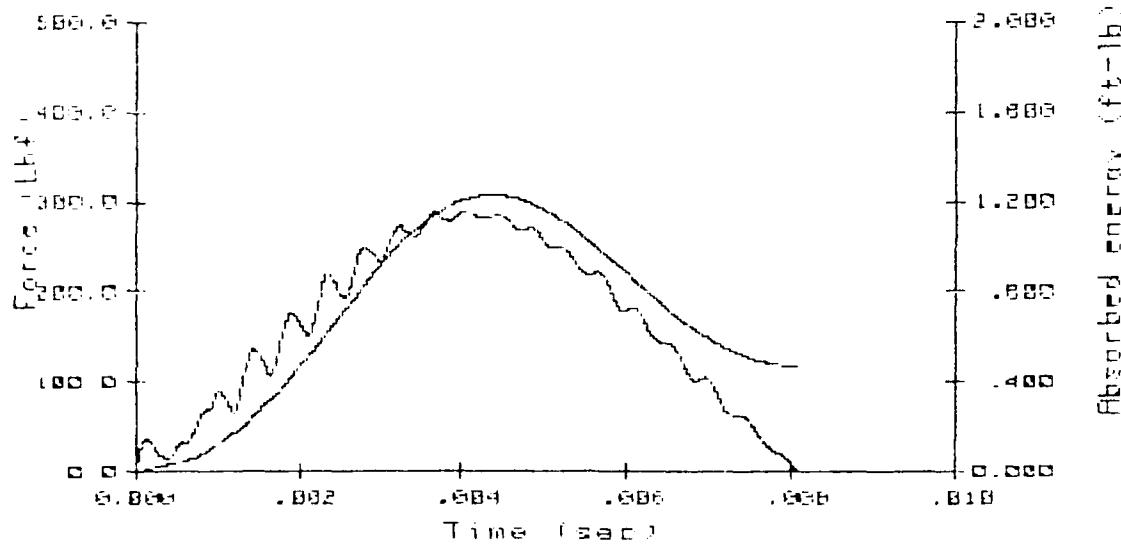
2/16/84

=====
 INSTRUMENTED IMPACT TEST
 =====

81-5 GR/BMI #11

Drop weight =	7.00Lb	Data disk =	MAT00806
Tup radius =	.500in	DRM scale =	.2Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V_0 =	3.27ft/s		
F.E. =	1.16ft-Lb	V_f (calc) =	-2.56ft/s

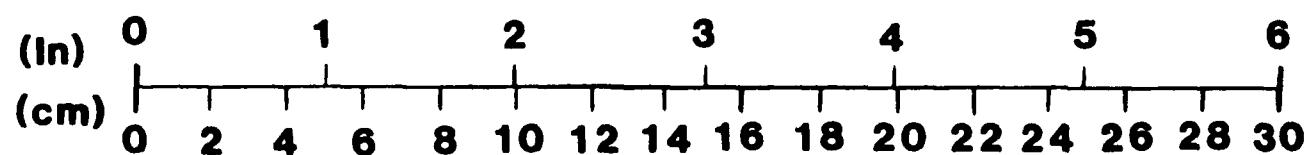
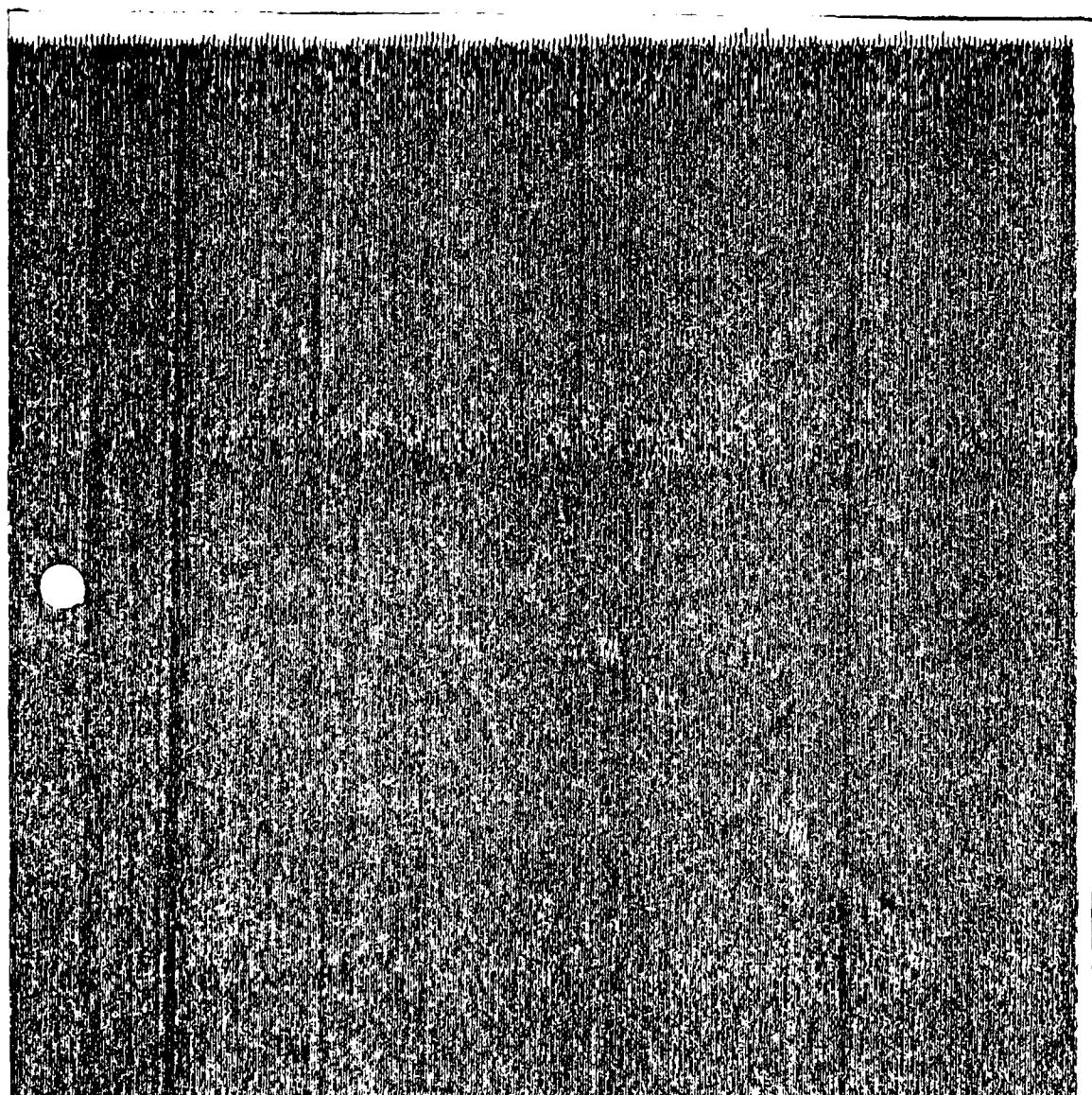
Load(Lb)	Time(s)	EO(Ft-Lb)	Disp(in)	
287.8	4.033E-3	1.21	.1133	Maximum force
283.6	4.378E-3	1.23	.1142	Maximum energy
283.6	4.378E-3	1.23	.1142	Maximum displacement
1.6	8.088E-3	.47	.0380	Final values



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81-5 GR/BMI

#11



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T-300/V378A Cloth

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NADC/ETI -8200 DROP TEST FACILITY

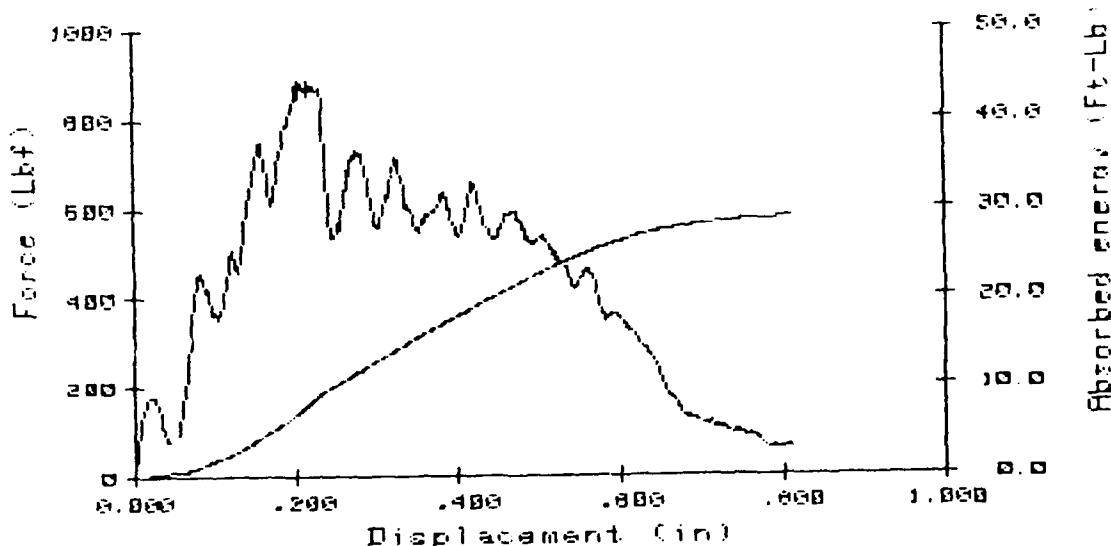
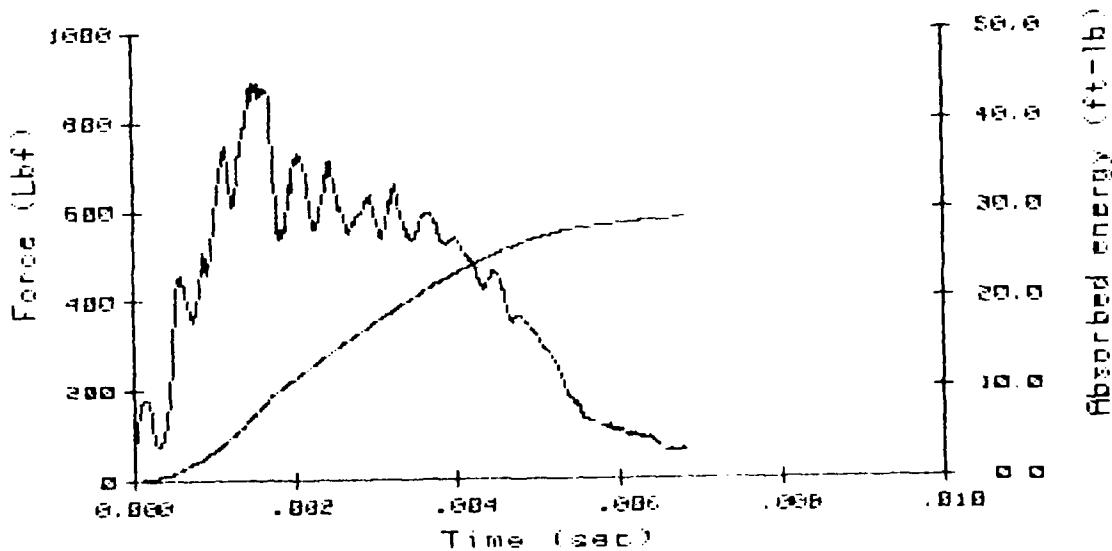
3/5/84

=====
INSTRUMENTED IMPACT TEST
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T300/V378A #1

Drop weight = 31.36Lb Data dist = MAT00907
 Tip radius = 0.000in DRM scale = .8In/Div
 Temperature = 74.0 F Flag grid = .040in
 $V_0 = 11.49\text{ft/s}$
 E.E. = 64.34ft-Lb $V_f(\text{calc}) = 8.77\text{ft/s}$

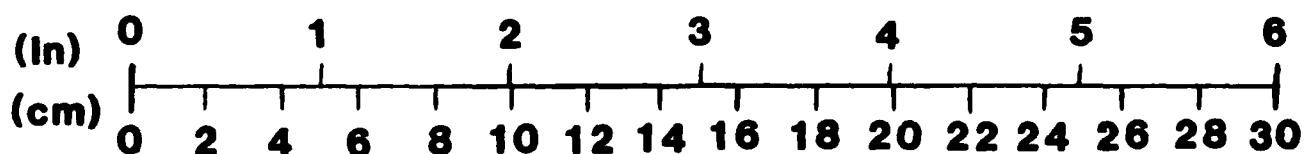
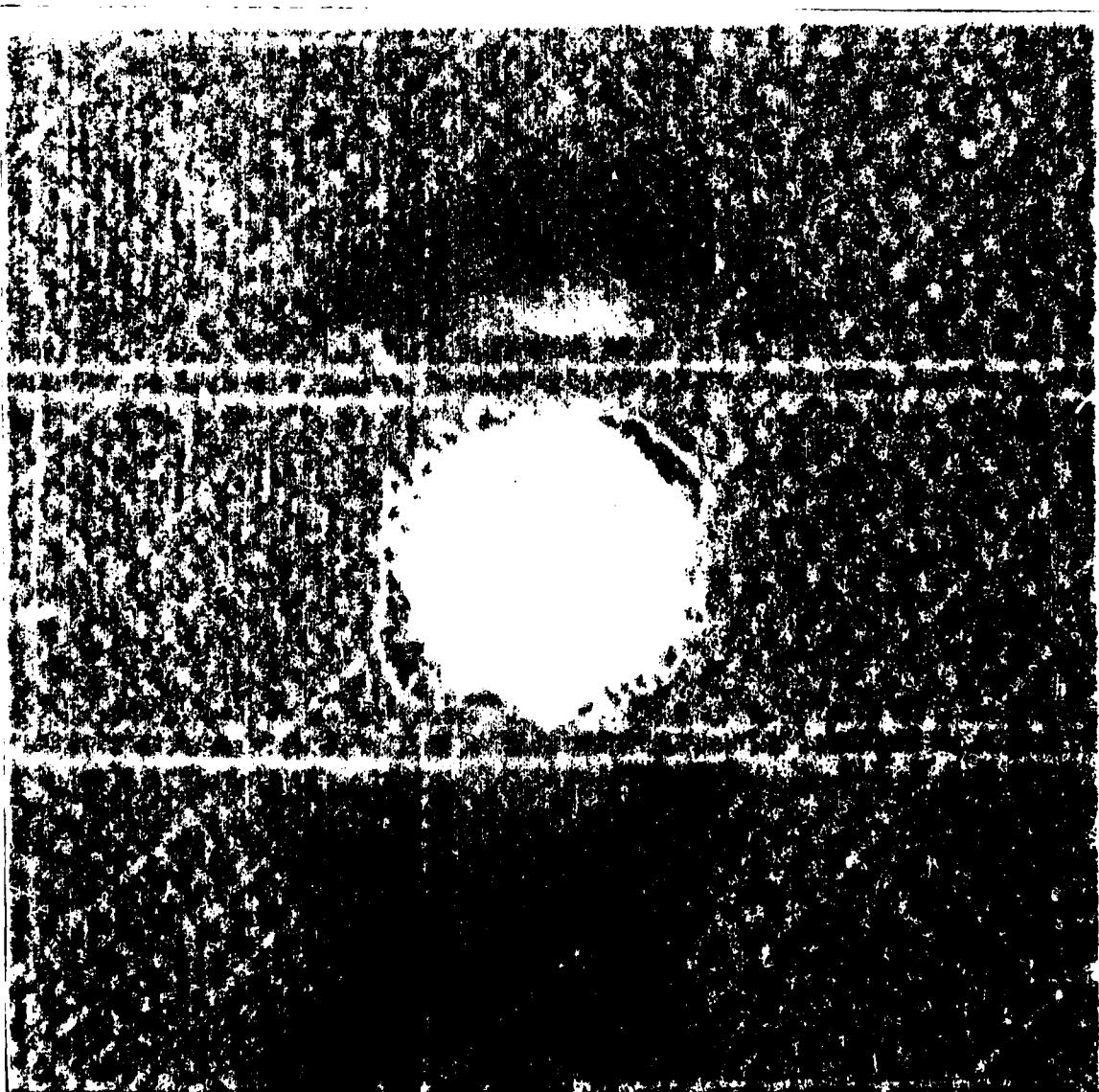
Load (Lb)	Time (s)	E_0 (Ft-Lb)	Disp (in)	
888.4	1.585E-3	8.06	.2163	Maximum force
62.9	6.815E-3	29.00	.8095	Maximum energy
62.9	6.815E-3	29.00	.8095	Maximum displacement
62.9	6.815E-3	29.00	.8095	Final values



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T300/V378A

1



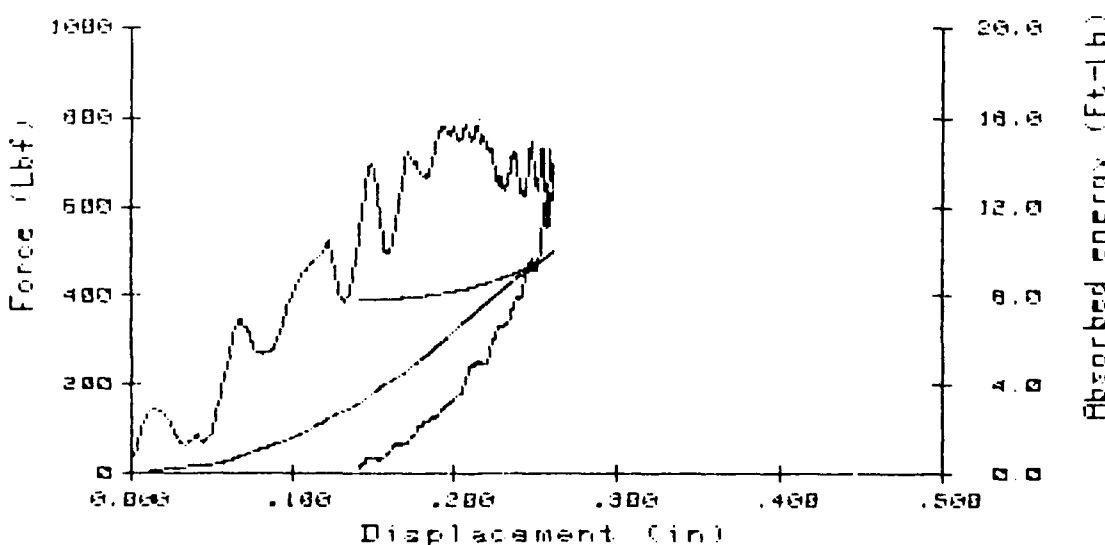
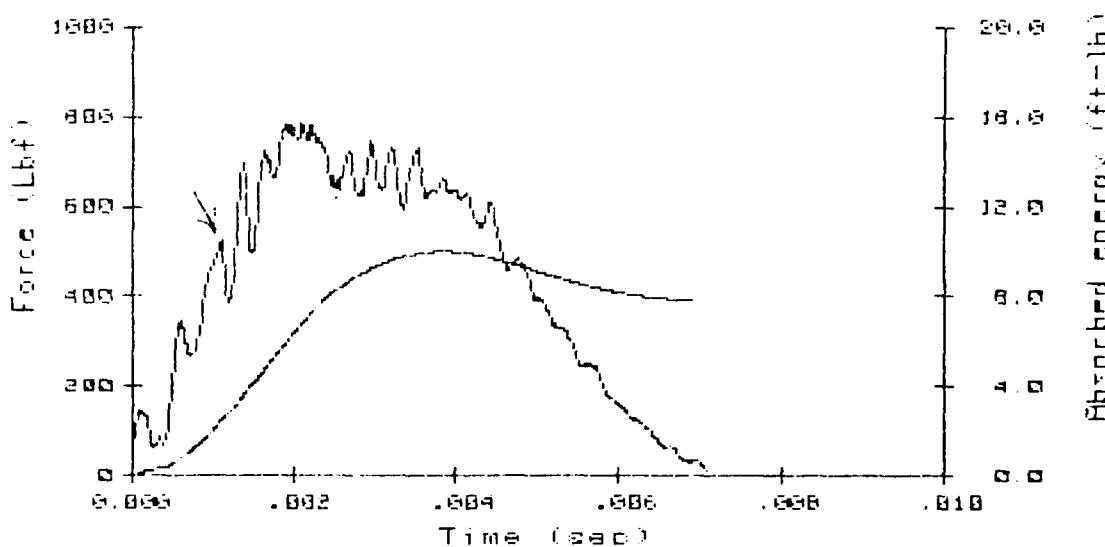
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INSTRUMENTED IMPACT TEST
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T300/V378A #2

Drop weight = 7.00Lb Data disk MAT00906
 Tup radius = .500in DRM scale .8Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 9.52ft/s abs(V_f) = 5.95ft/s
 K.E. = 9.86ft-Lb V_f (calc) = -4.44ft/s

Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
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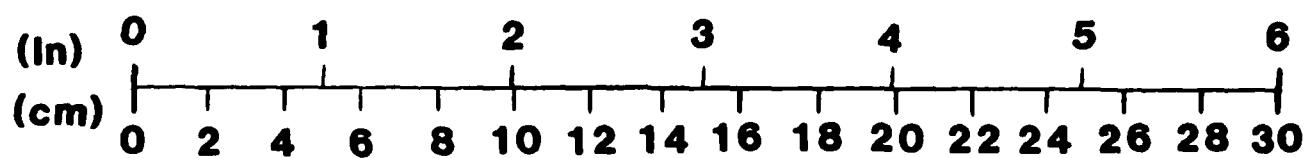
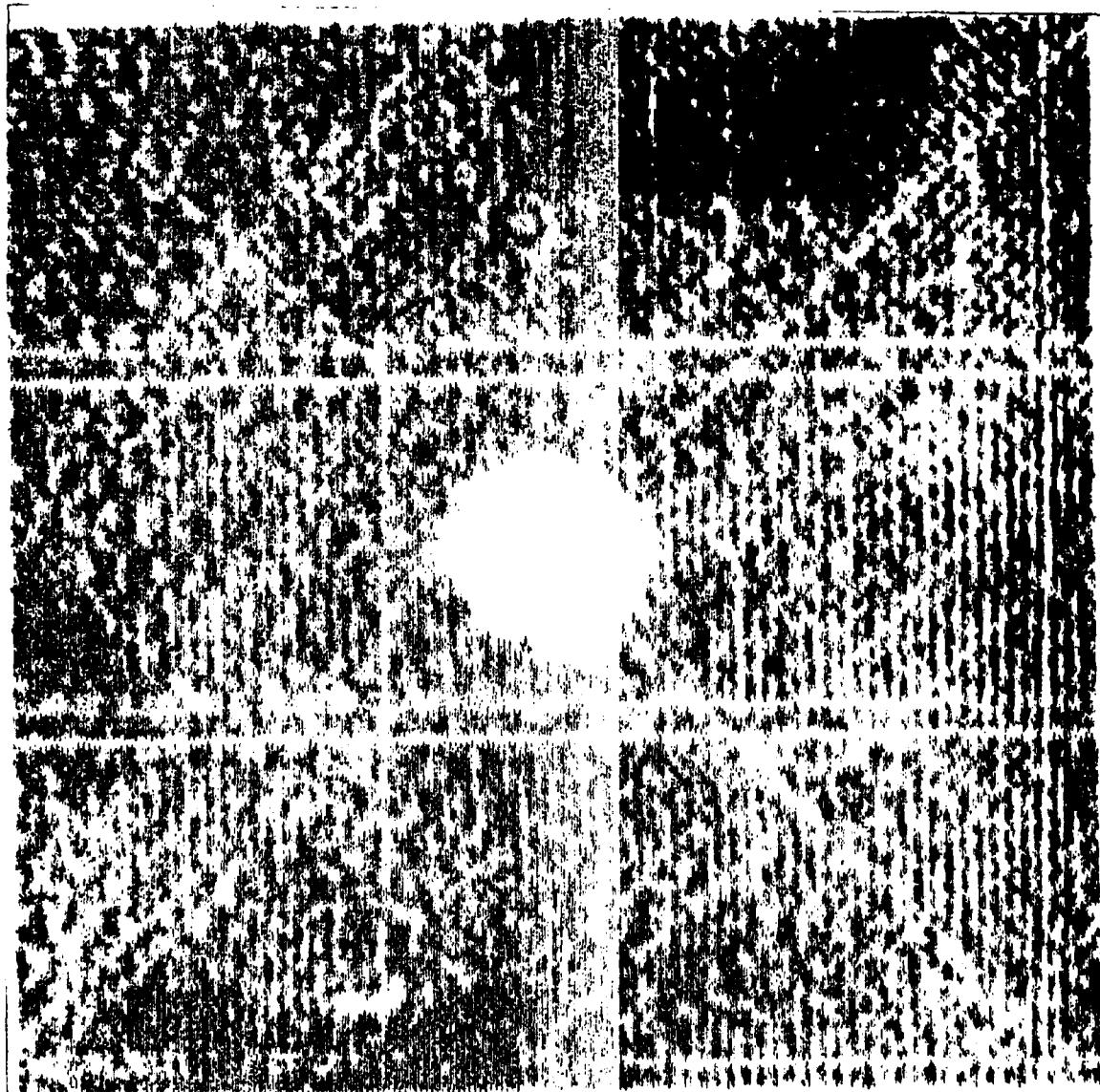
523.4	1.105E-3	2.46	.1224	Initial damage
787.7	2.105E-3	6.82	.2062	Maximum force
660.0	3.835E-3	10.01	.2610	Maximum energy
660.0	3.835E-3	10.01	.2610	Maximum displacement
14.4	7.055E-3	7.80	.1420	Final values



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T300/V378A

#2



NADC-85023-60

NADC LTI-8201 DFLF TEST FACILITY

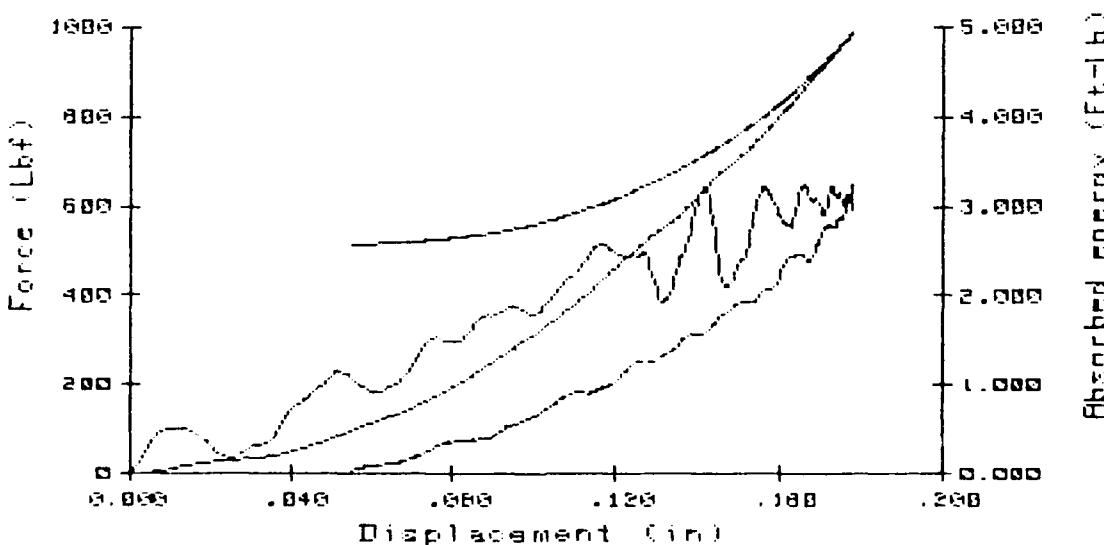
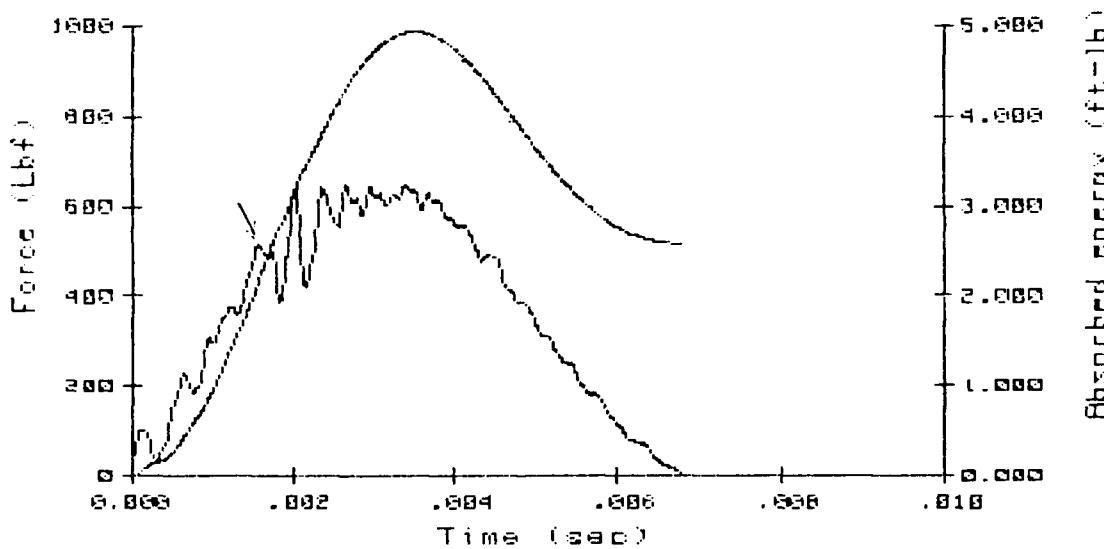
3/5/84

=====
INSTRUMENTED IMPACT TEST
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T300/V378A #3

Drop weight	=	7.00LB	Data disk	MAT00905	
Tup radius	=	.500in	DRM scale	.4Kn/Div	
Temperature	=	74.0 F	Flag grid=	.040in	
V_0	=	6.67ft/s	$\text{abs}(V_f)$	=	5.56ft/s
K.E.	=	4.83ft-Lb	$V_f(\text{calc})$	=	-4.59ft/s

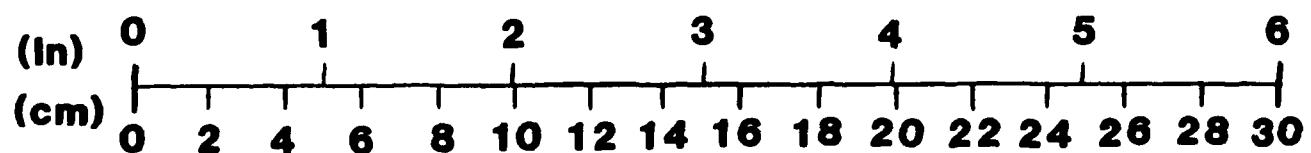
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
516.2	1.565E-3	2.15	.1162	Initial damage
649.2	3.385E-3	4.92	.1778	Maximum force
635.8	3.505E-3	4.93	.1780	Maximum energy
635.8	3.505E-3	4.93	.1780	Maximum displacement
7.2	6.755E-3	2.58	.0551	Final values



NADC-85023-60

T300/V378A

#3

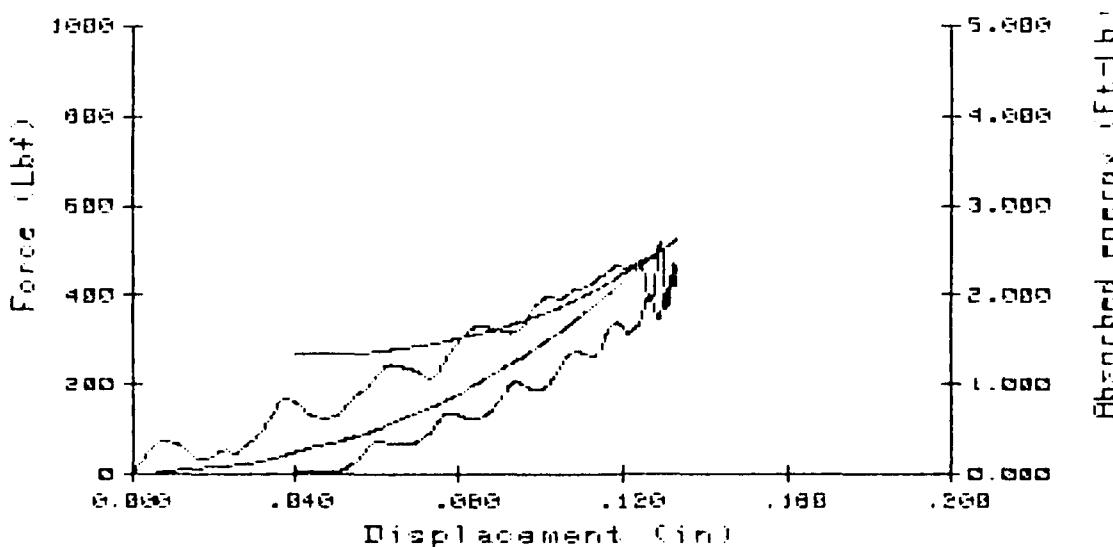
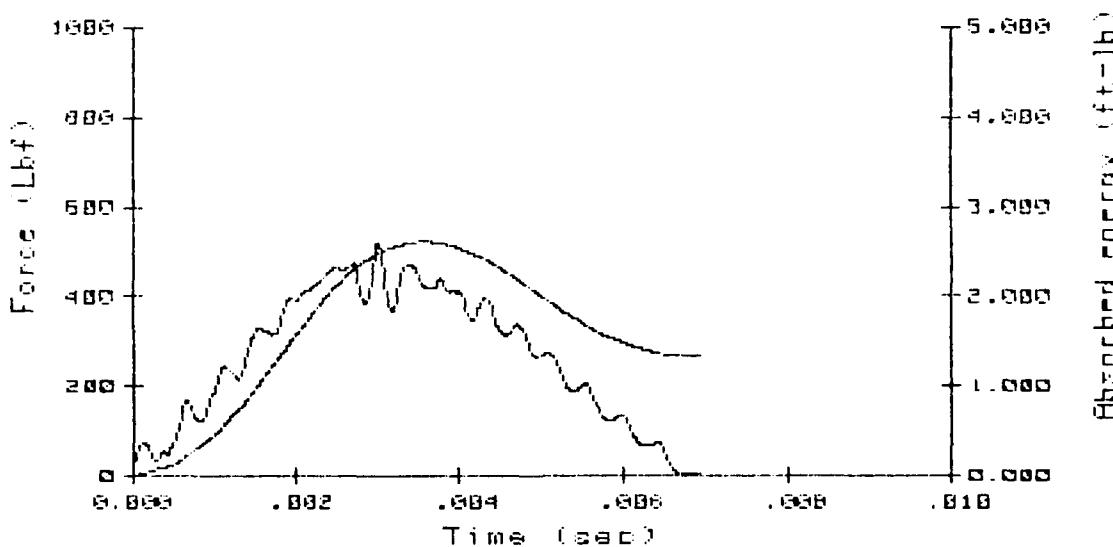


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 INSTRUMENTED IMPACT TEST
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T300/V37BA #4

Drop weight =	7.00LB	Data disk =	MAT00904
Tup radius =	.500in	DRM scale =	.2Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V ₀ =	4.83ft/s	abs(V _f) =	4.12ft/s
K.E. =	2.54ft-Lb	V _f (calc) =	-3.36ft/s

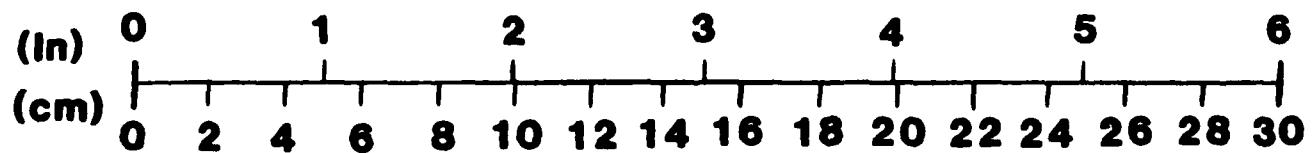
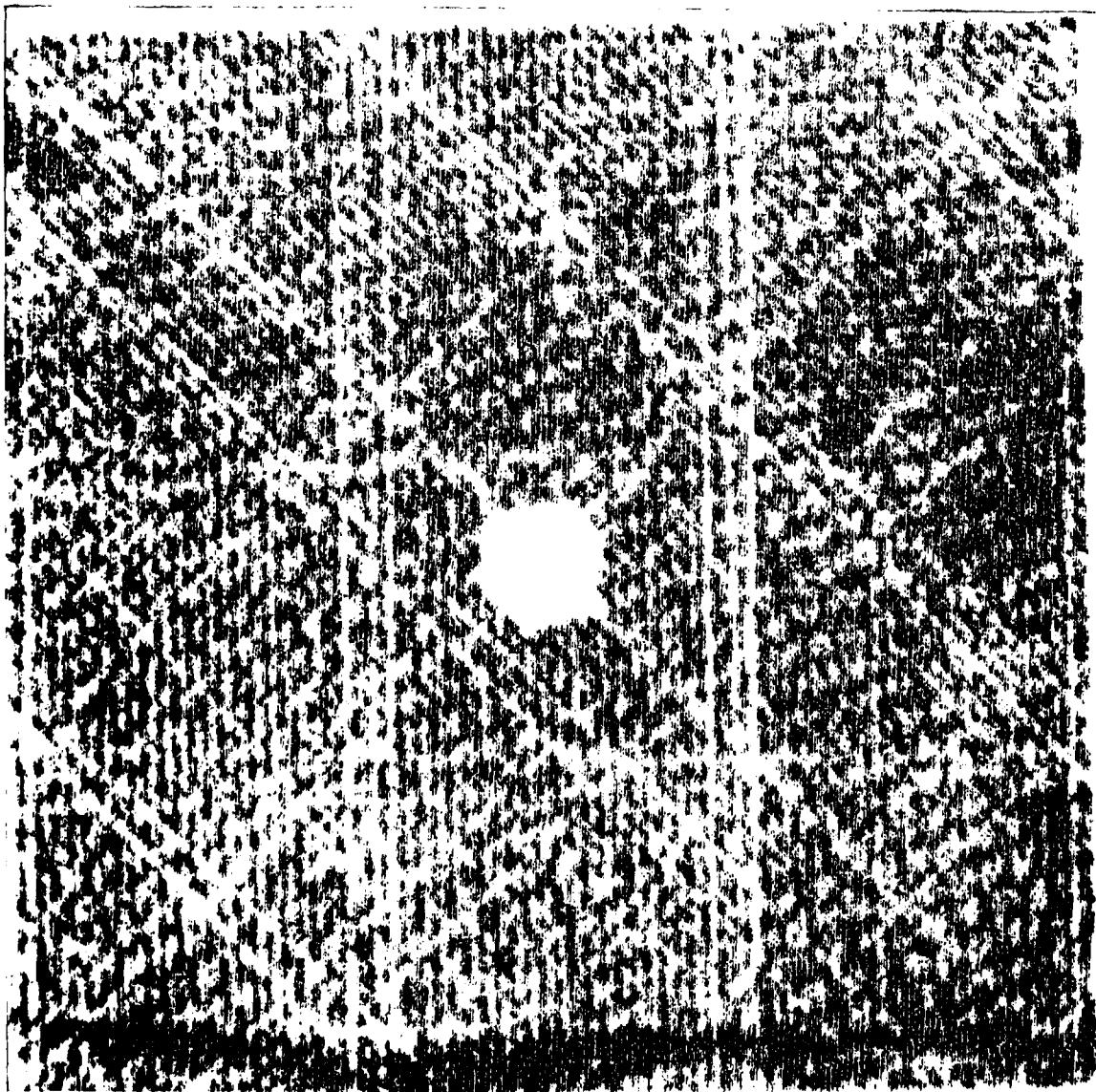
Load (Lb)	Time (s)	E ₀ (Ft-Lb)	Disp (in)	
473.0	2.705E-3	2.29	.1235	Initial damage
521.1	3.025E-3	2.49	.1288	Maximum force
423.1	3.555E-3	2.61	.1323	Maximum energy
423.1	3.555E-3	2.61	.1323	Maximum displacement
4.0	6.905E-3	1.33	.0403	Final values



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T300/V378A

#4



NADC-85023-60

NAL-211-8200 Drop Test Facility

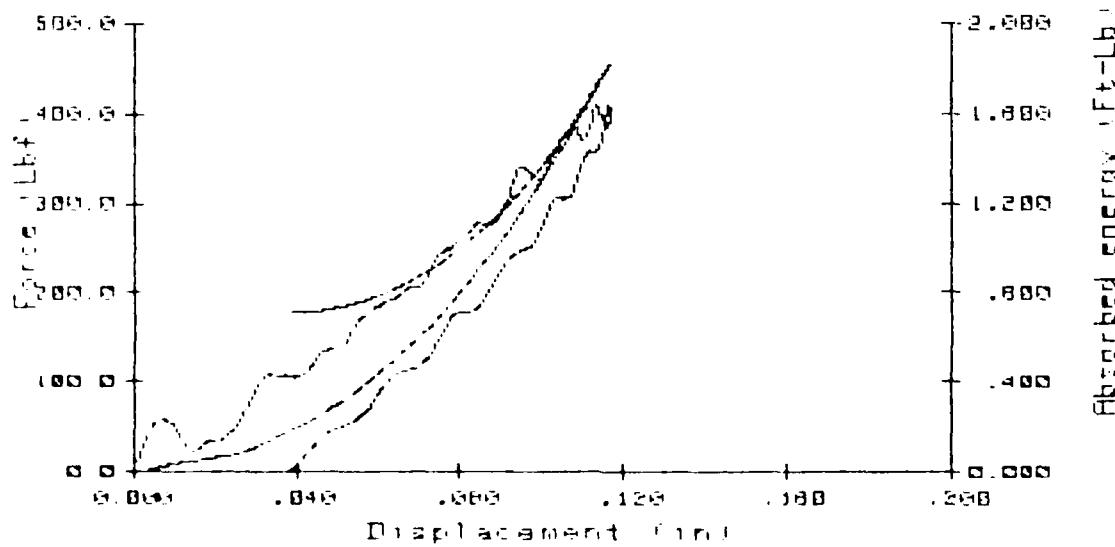
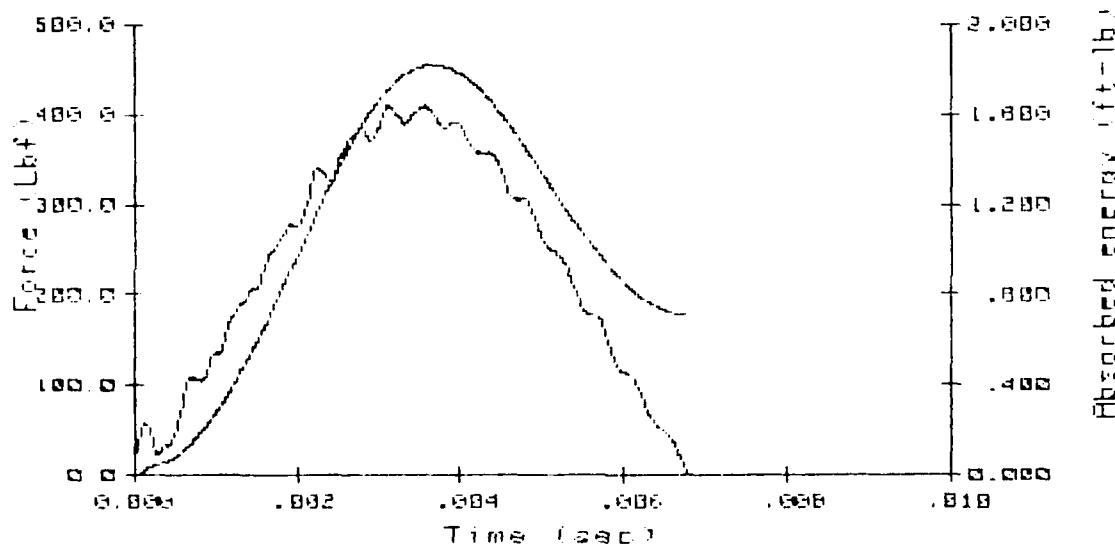
170E-04

=====
INSTRUMENTED IMPACT TEST
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T300/VG78A 15

Drop weight = 7.00LB Data disk MAT00908
 Tup radius = .500in DRM scale .2in/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 4.02ft/s abs(V_f) = 3.88ft/s
 F.E. = 1.75ft-Lb V_f (calc) = -3.13ft/s

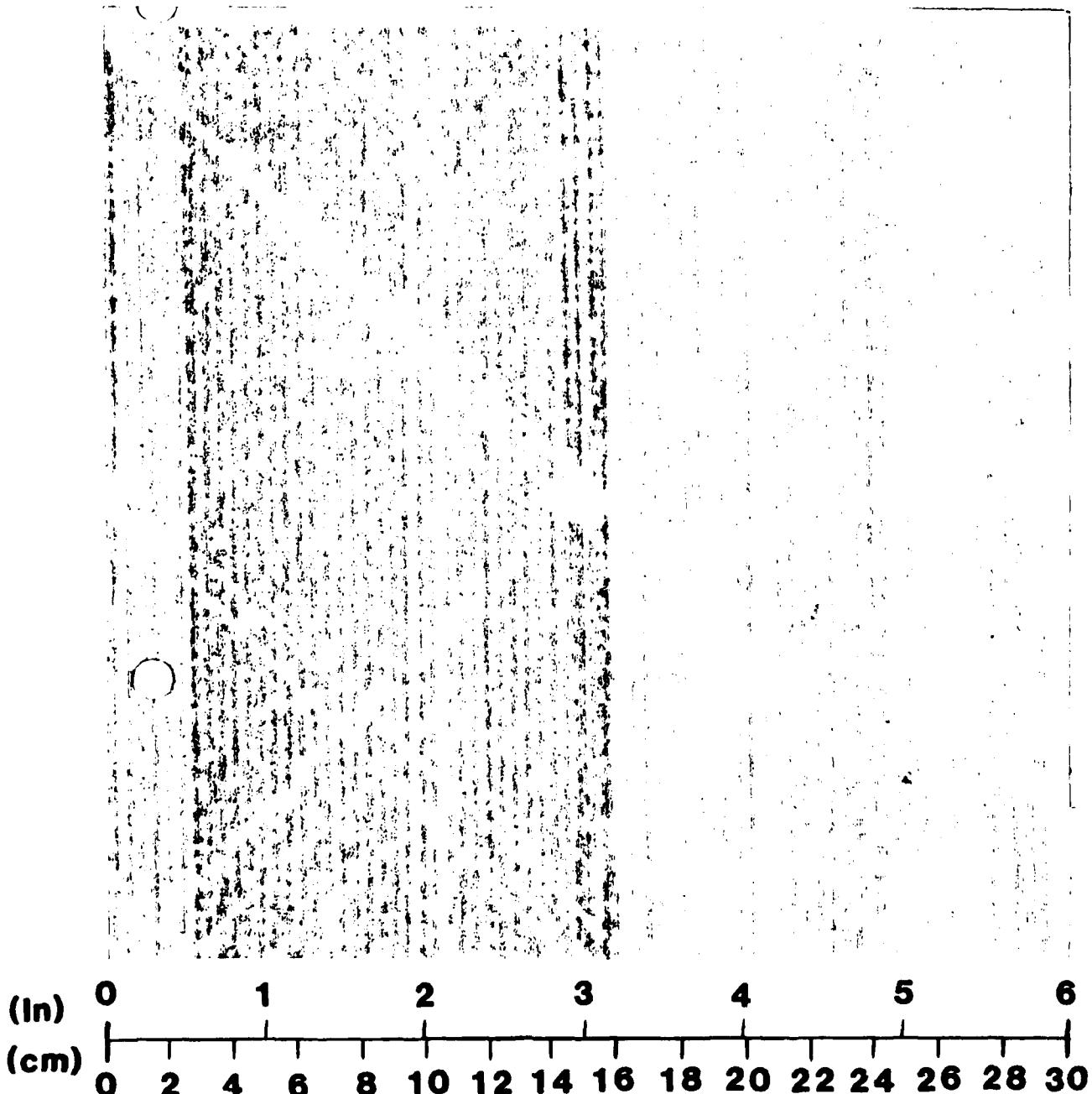
Load(LB)	Time(s)	E0(Ft-Lb)	Disp(in)	
411.0	3.105E-3	1.71	.1131	Maximum force
402.0	3.665E-3	1.82	.1165	Maximum energy
402.0	3.665E-3	1.82	.1165	Maximum displacement
3.1	6.785E-3	.71	.0391	Final values



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T300/V378A

#5



NADC-85023-60

AEROSPACE TEST FACILITY

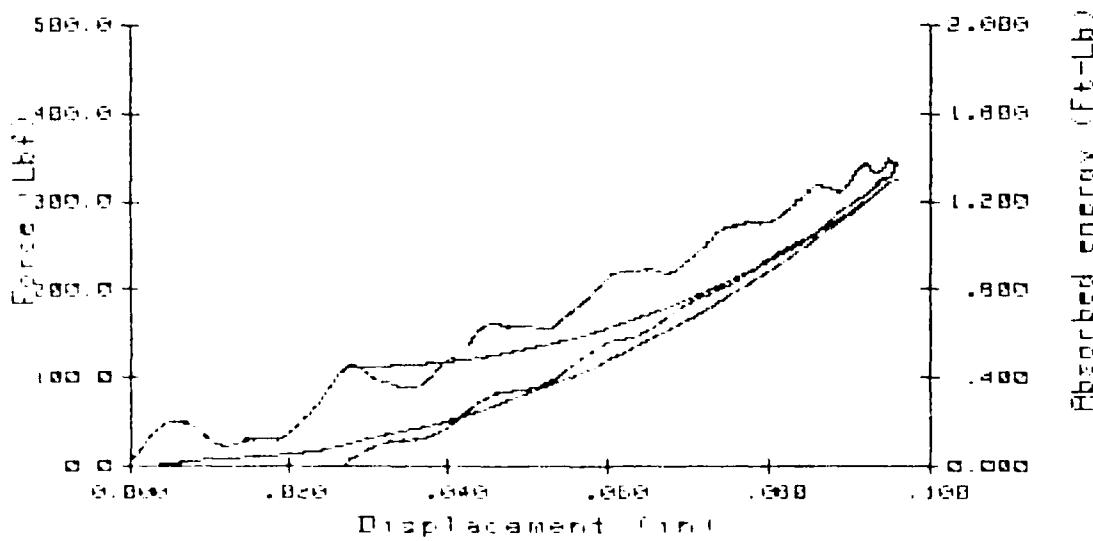
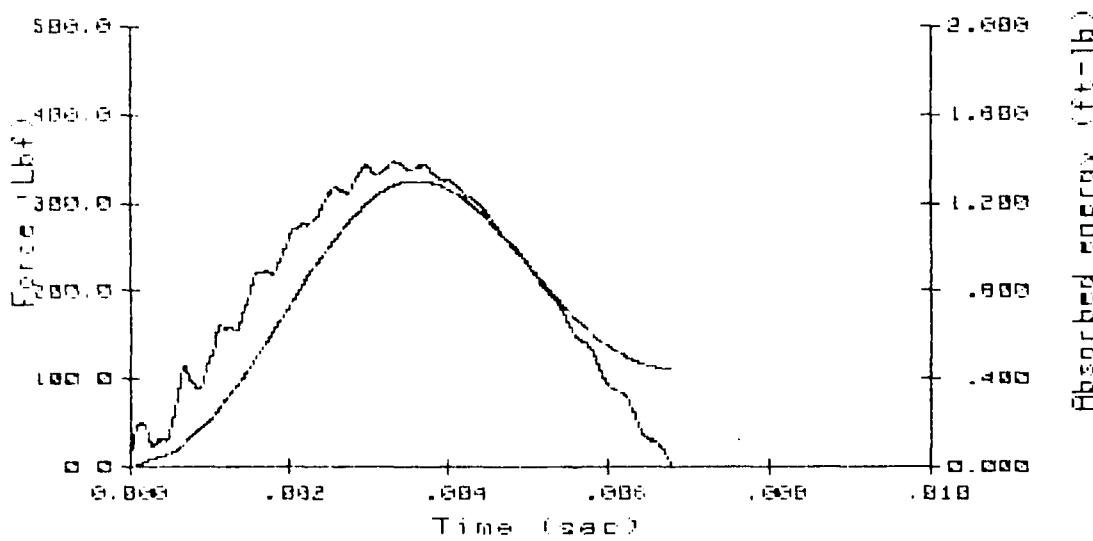
3/15/85

INSTRUMENTED IMPACT TEST

T300/VZ78A #6

Drop weight = 7.00LB Data dist MAT01001
 Tup radius = .500in DRM scale .2in/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 3.38ft/s abs(Vf) = 3.25ft/s
 I.E. = 1.24ft-Lb Vf(calc) = -2.74ft/s

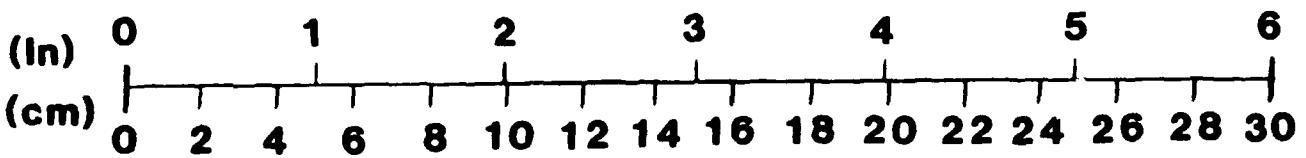
Load (Lb)	Time (s)	E_0 (Ft-Lb)	Disp (in)	
347.6	3.313E-3	1.28	.0950	Maximum force
342.2	3.603E-3	1.30	.0958	Maximum energy
342.2	3.603E-3	1.30	.0958	Maximum displacement
4.0	6.768E-3	.45	.0271	Final values



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T300/V378A

#6



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XAS/9101-3

NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

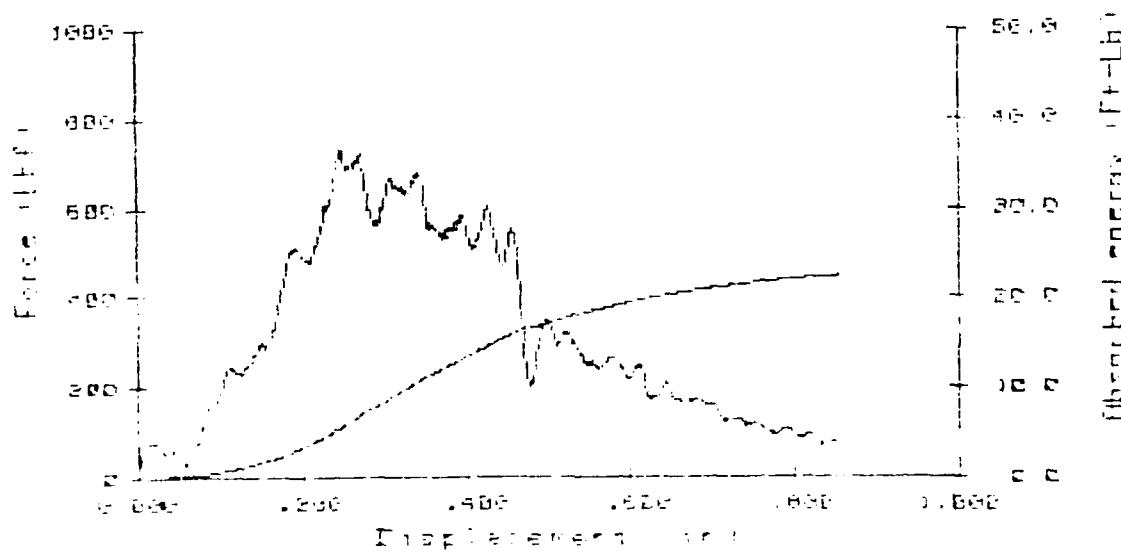
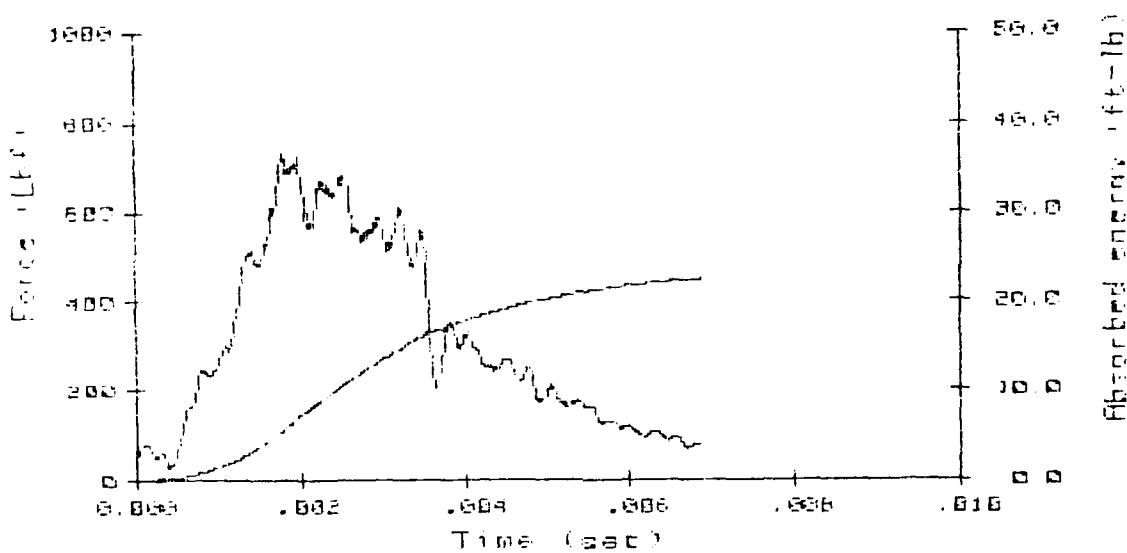
4/26/84

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 INSTRUMENTED IMPACT TEST
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GRUBIN 5101-3 #1

Drop weight =	31.36Lb	Data disk =	MAT01201
Tup radius =	.500in	DRM scale =	.8Kg/Div
Temperature =	74.0 F	Flag grid =	.040in
V ₀ =	11.49ft/s		
I.E. =	64.34ft-Lb	V _f (calc) =	9.51ft/s

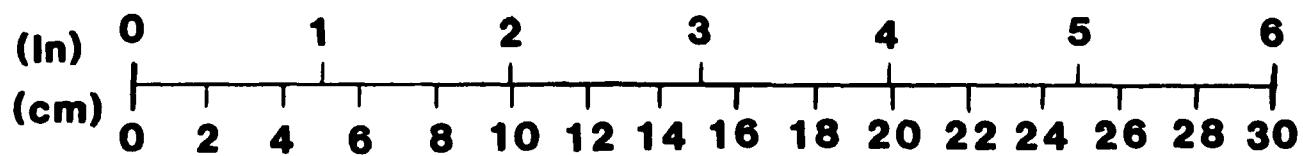
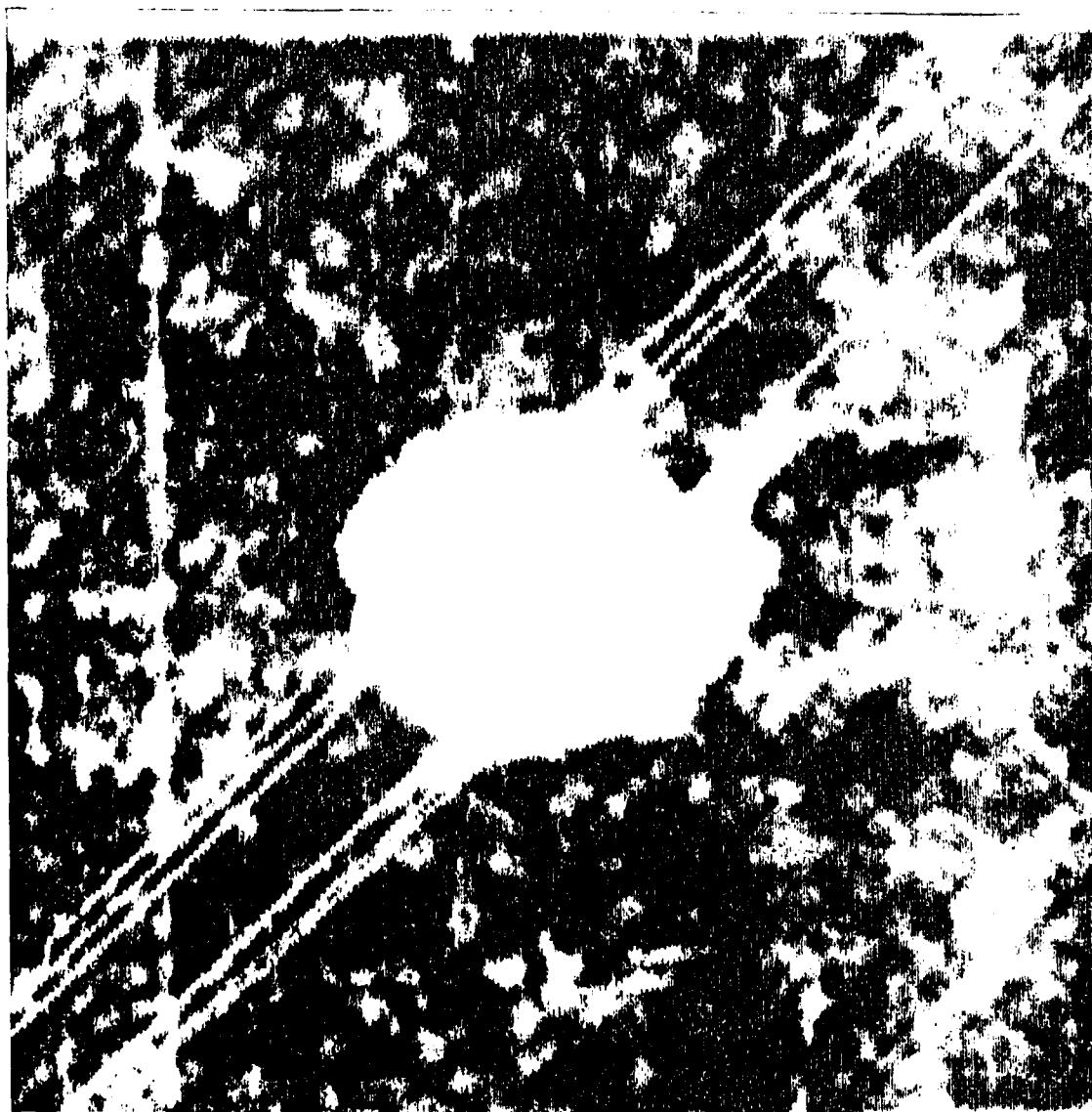
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
730.8	1.805E-3	5.71	.2483	Maximum force
77.3	6.885E-3	22.50	.8565	Maximum energy
77.3	6.885E-3	22.50	.8565	Maximum displacement
77.3	6.885E-3	22.50	.8565	Final values



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GR/BMI 9101-3

#1



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NADC/ETI-8200 DROP TEST FACILITY

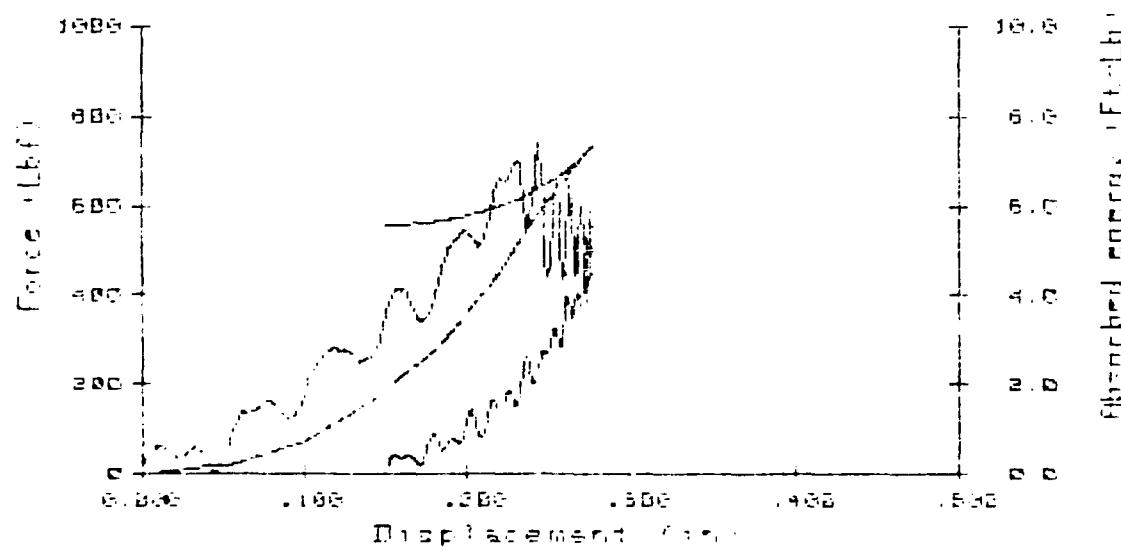
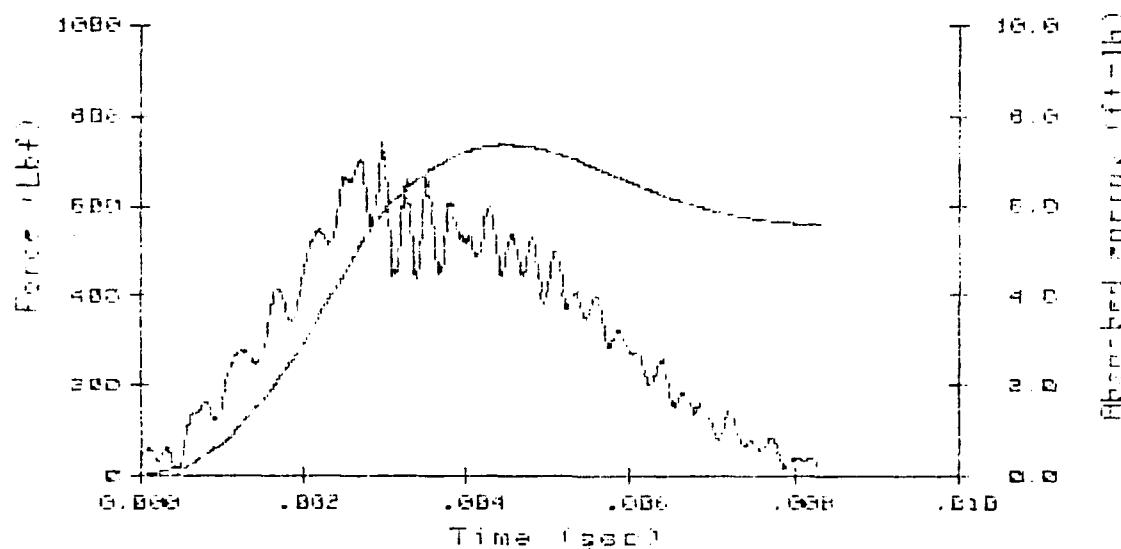
4/26/84

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INSTRUMENTED IMPACT TEST
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GE/BM1 9101-3 #2

Drop weight = 7.00LB Data disk MAT01107
 Tip radius = .500in DRM scale .8Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 8.13ft/s abs(V_f) = 5.21ft/s
 K.E. = 7.18ft-Lb $V_f(\text{calc})$ = -3.96ft/s

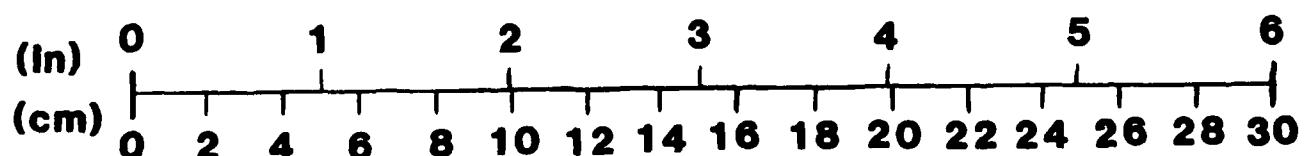
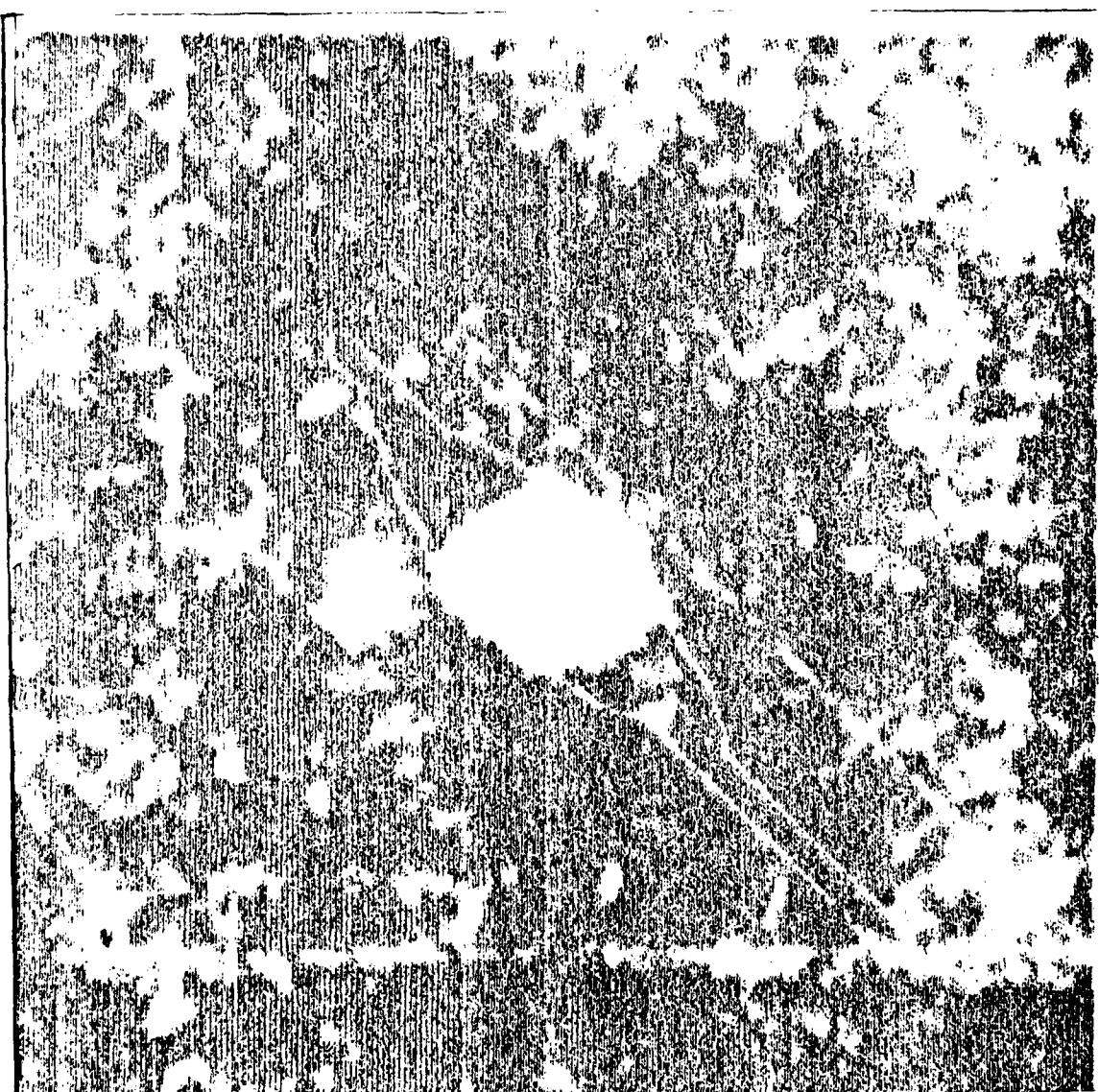
Load (LB)	Time (s)	E_0 (Ft-Lb)	Disp (in)	
741.0	2.995E-3	5.86	.2441	Maximum force
509.0	4.505E-3	7.35	.2767	Maximum energy
509.0	4.505E-3	7.35	.2767	Maximum displacement
14.4	8.295E-3	5.57	.1514	Final values



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GR/BMI 9101-3

#2



NADC-85023-60

NADC-ETI-8200 DFR TEST FACILITY

4/26/84

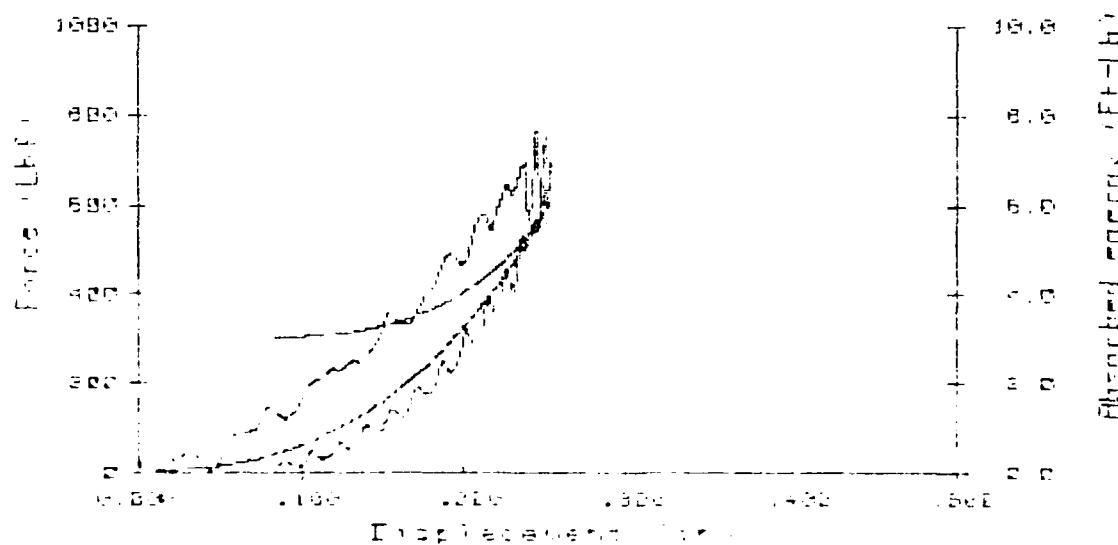
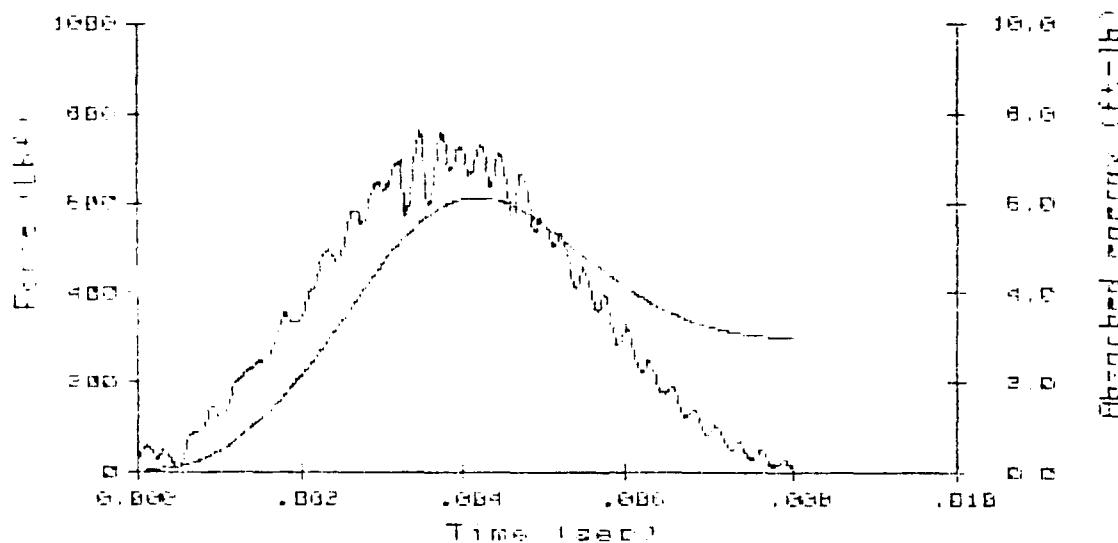
INSTRUMENTED IMPACT TEST

SF/EMI S101-3 #3

Drop weight = 7.00LB Data disk MAT01104
 Tup radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid = .040in
 V_0 = 7.41ft/s abs(Vf) = 6.29ft/s
 I.E. = 5.96ft-Lb Vf(calc) = -5.25ft/s

Load (LB)	Time (s)	E0 (Ft-Lb)	Disp (in)
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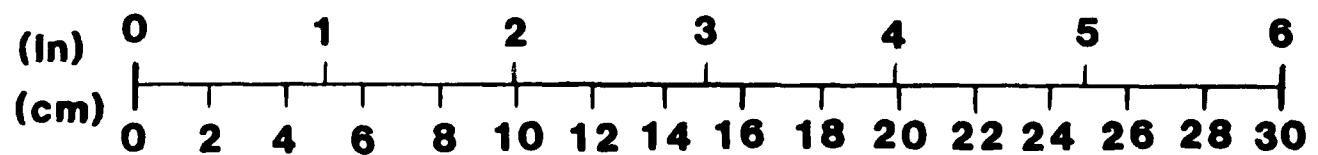
766.1	2.465E-3	5.54	.2450 Maximum force
718.5	4.185E-3	.6.11	.2549 Maximum energy
718.5	4.185E-3	.6.11	.2549 Maximum displacement
6.3	7.985E-3	3.02	.0841 Final values



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GR/BMI 9101-3

#3

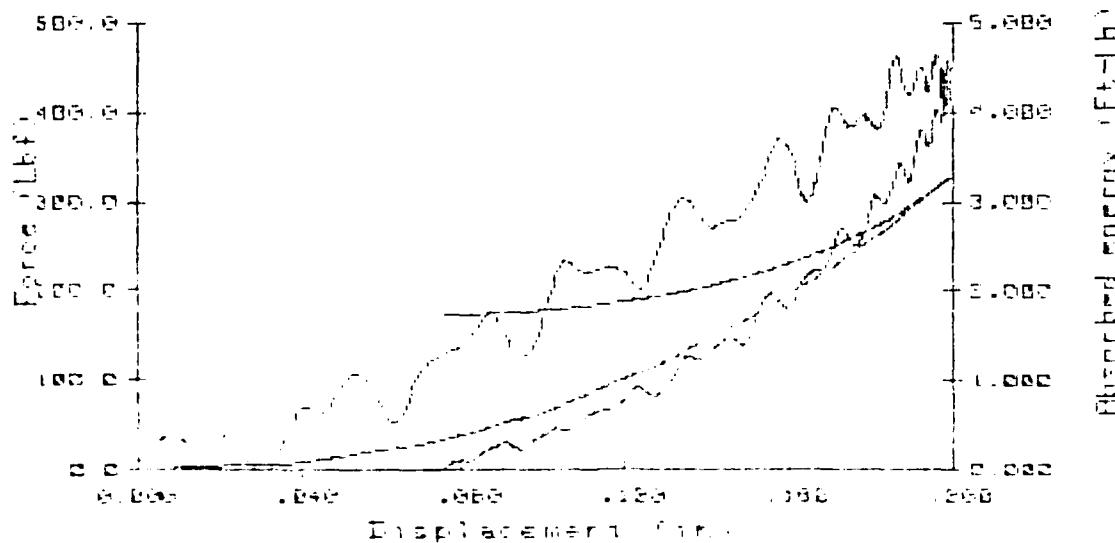
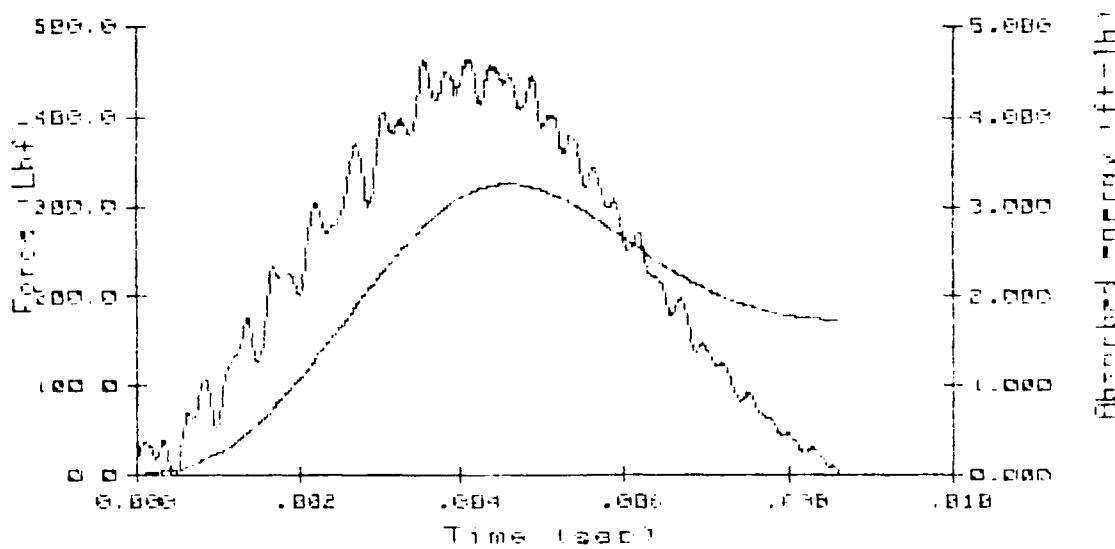


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INSTRUMENTED IMPACT TEST
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GR/BMI 9101-3 #4

Drop weight =	7.00LB	Data disk =	MAT01103
Tup radius =	.500in	DRM scale =	.2Kg/Div
Temperature =	74.0 F	Flag grid =	.040in
V0 =	5.384ft/s	abs(Vf) =	4.57ft/s
F.E. =	3.14ft-Lb	Vf(celc) =	-3.65ft/s

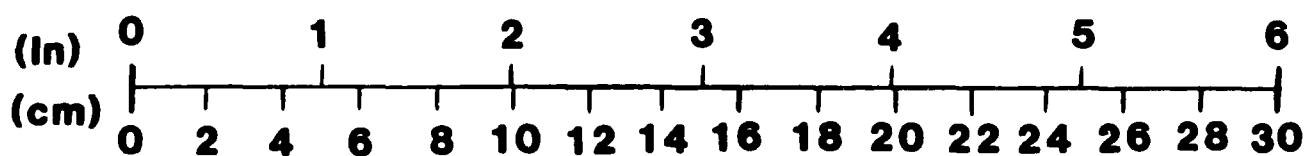
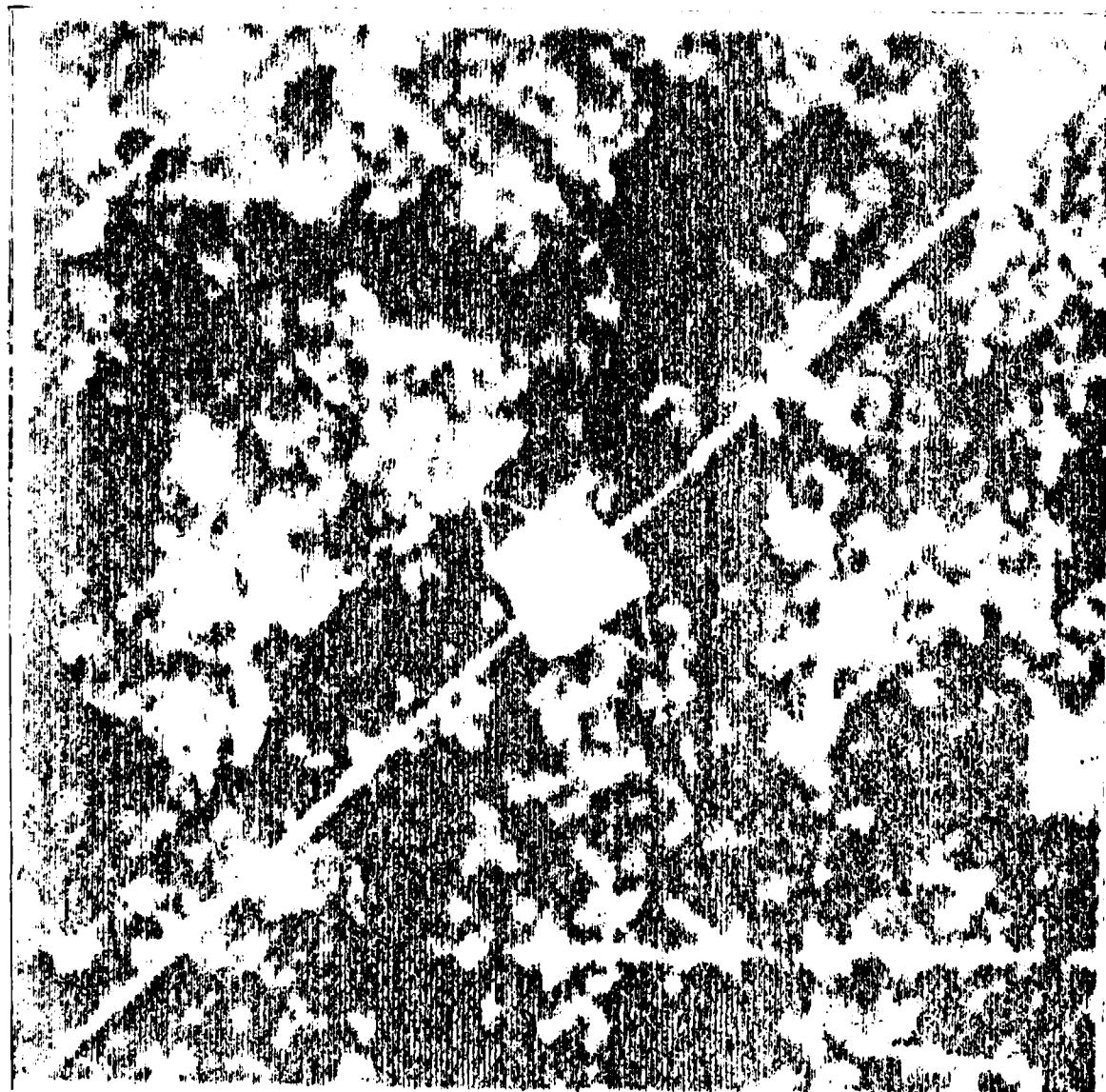
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
454.5	4.095E-3	3.15	.19e1	Maximum force
446.0	4.595E-3	3.25	.1991	Maximum energy
446.0	4.595E-3	3.26	.1991	Maximum displacement
3.6	8.505E-3	1.74	.0760	Final values



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GR/BMI 9101-3

#4

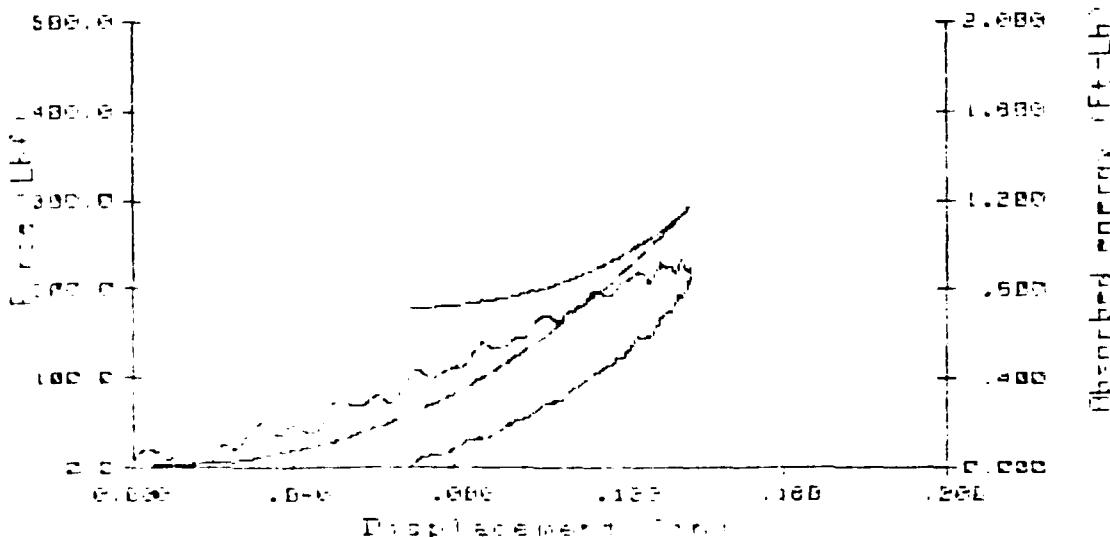
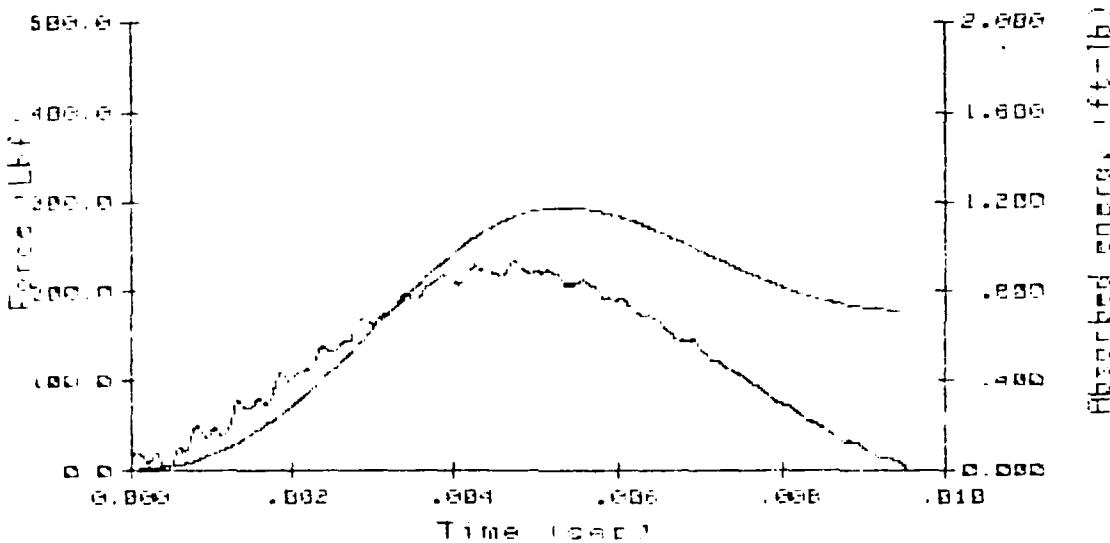


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 INSTRUMENTED IMPACT TEST
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GR/BMI 9101-3 #5

Drop weight =	7.00LB	Data disk =	MAT01101
Tup radius =	.500in	DRM scale =	.2Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V_0 =	3.17ft/s	$\text{abs}(V_f) =$	2.87ft/s
K.E. =	1.10ft-Lb	$V_f(\text{calc}) =$	-1.97ft/s

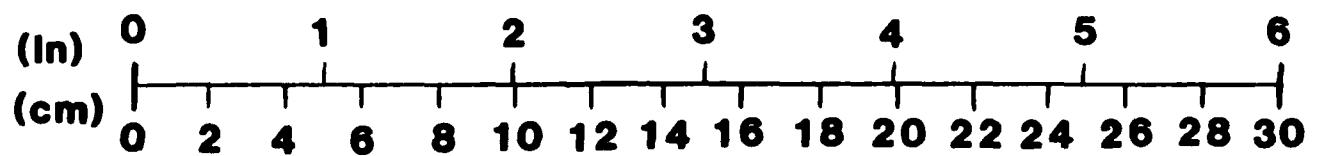
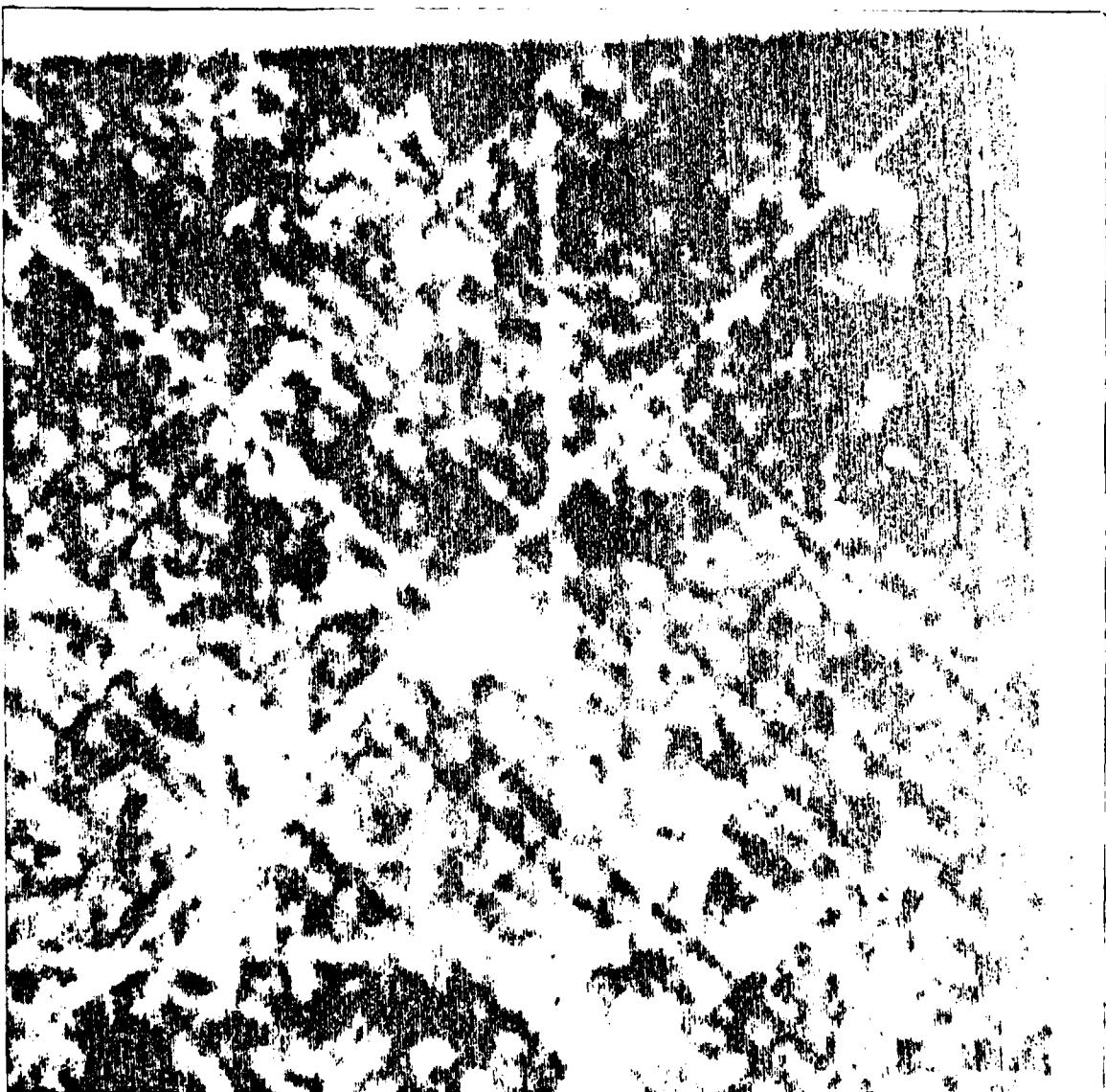
Load (Lb)	Time (s)	E_0 (Ft-Lb)	Disp (in)	
234.3	4.725E-3	1.13	.1346	Maximum force
209.5	5.355E-3	1.18	.1370	Maximum energy
209.5	5.355E-3	1.18	.1370	Maximum displacement
4.0	9.525E-3	.72	.0696	Final values



NADC-85023-60

GR/BMI 9101-3

#5



NADC-85023-60

NADC TETI-82000 DROP TEST FACILITY

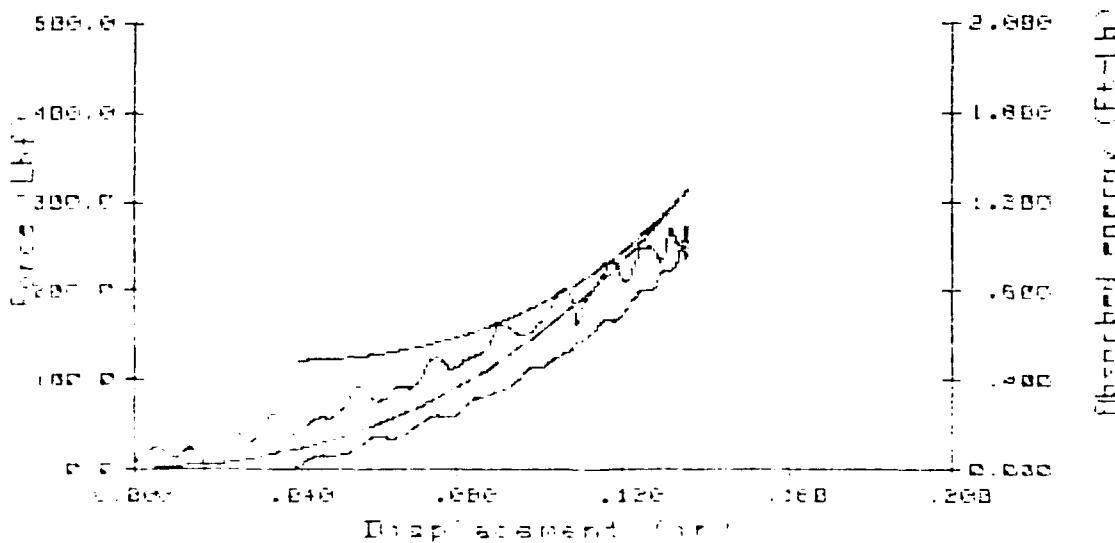
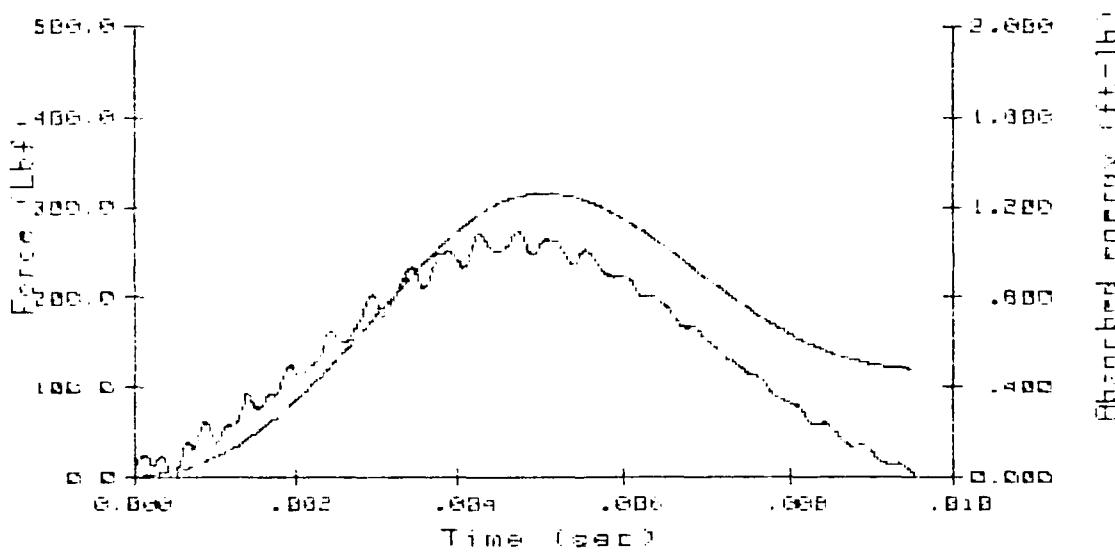
4/26/84

=====
INSTRUMENTED IMPACT TEST
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GFM-BMI 9101-2 #6

Drop weight =	7.00LB	Data disk =	MAT01007
Tup radius =	.500in	DRM scale =	.2Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V ₀	= 3.30ft/s	abs(V _f) =	3.14ft/s
K.E.	= 1.18ft-Lb	V _f (calc) =	-2.58ft/s

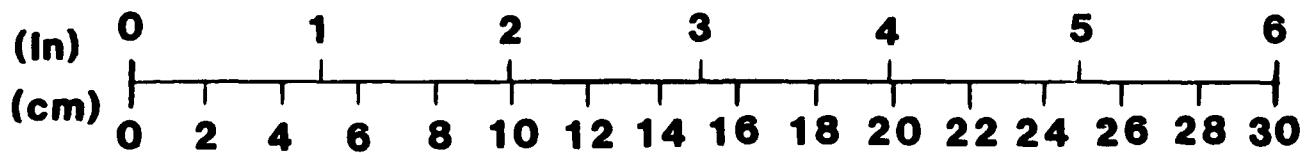
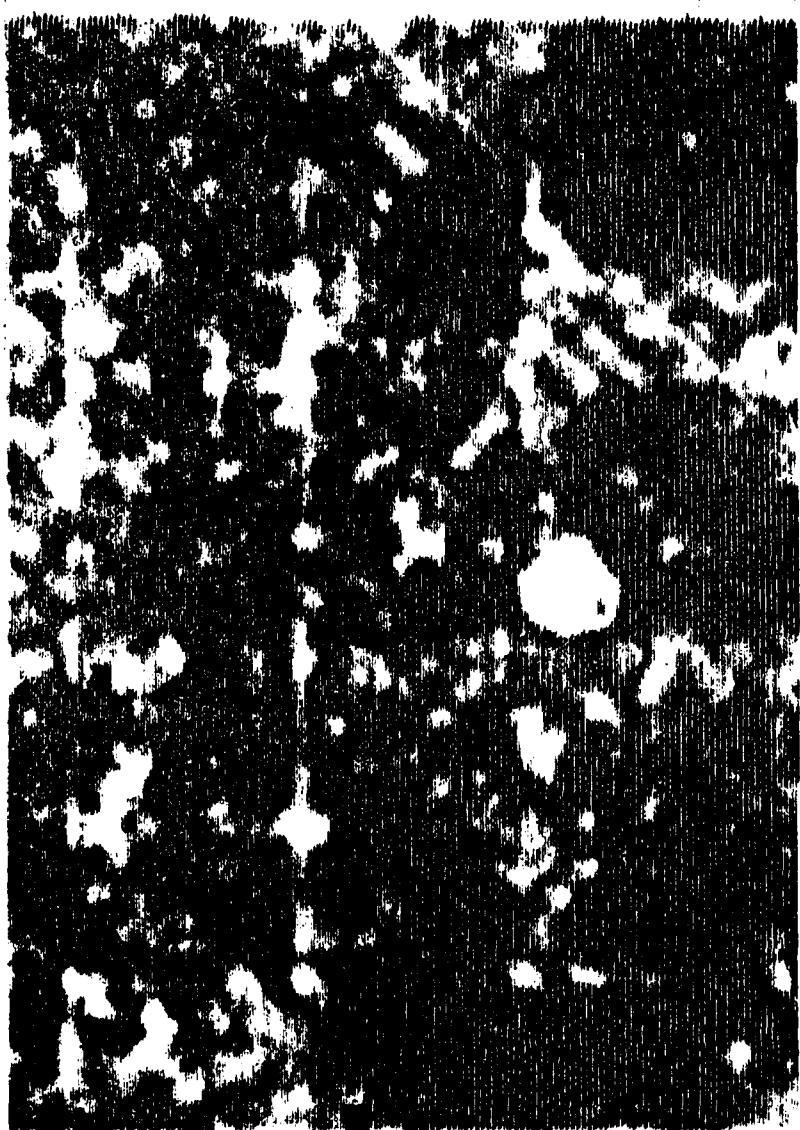
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
274.7	4.735E-3	1.25	.1351	Maximum force
264.4	5.055E-3	1.26	.1358	Maximum energy
264.4	5.055E-3	1.26	.1358	Maximum displacement
3.6	9.515E-3	.49	.0413	Final values



NADC-85023-60

GR/BMI 9101-3

#6



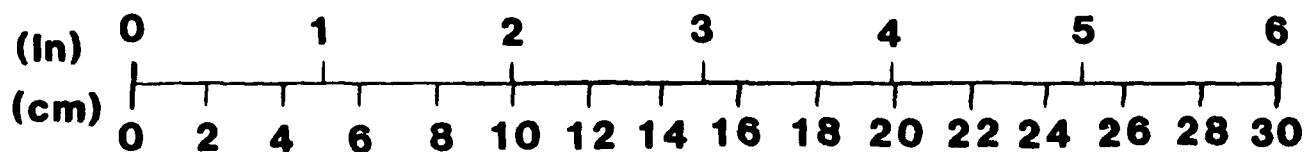
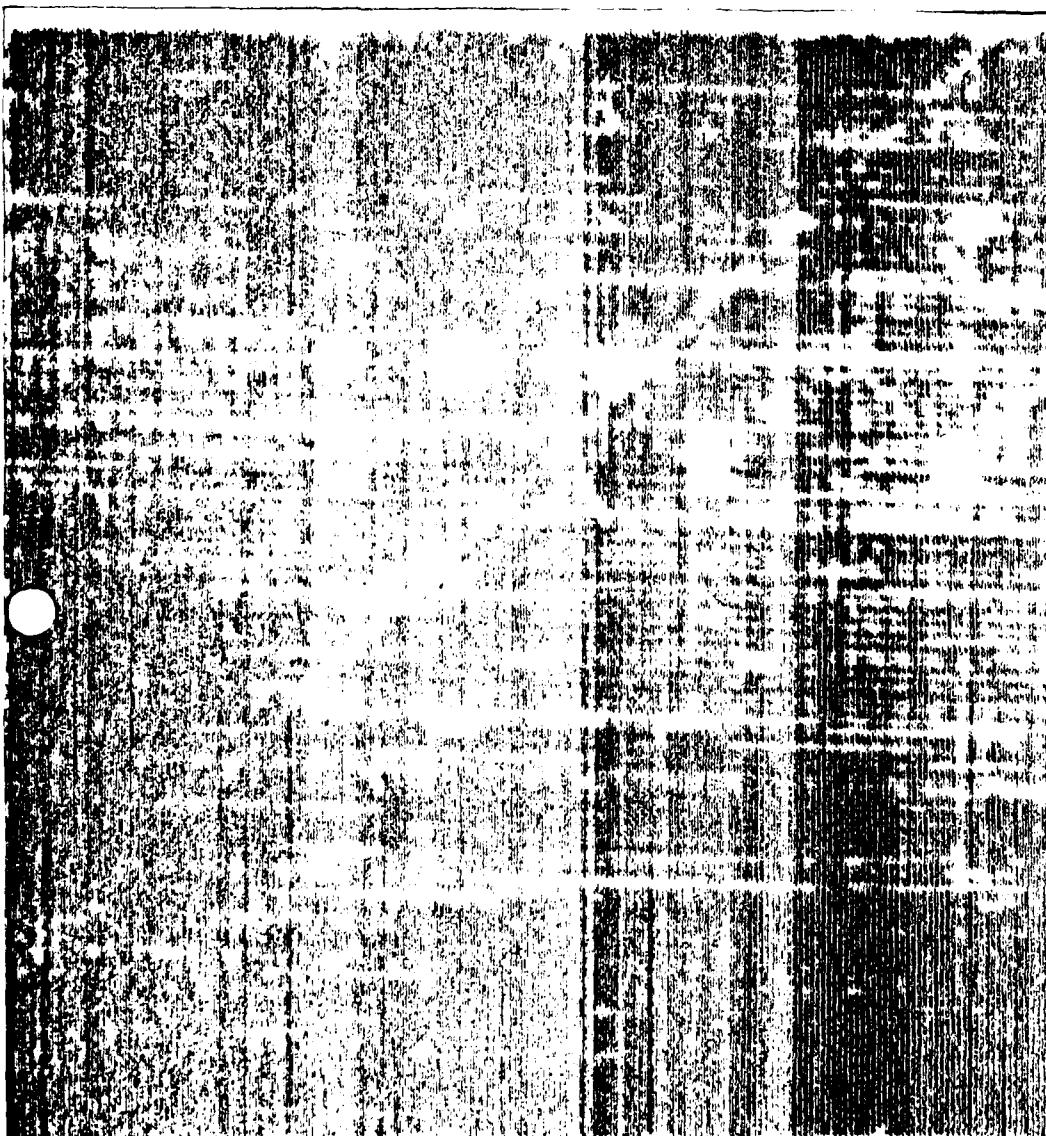
NADC-85023-60

T300/130B

NADC-85023-60

A130 GR/BMI

#8



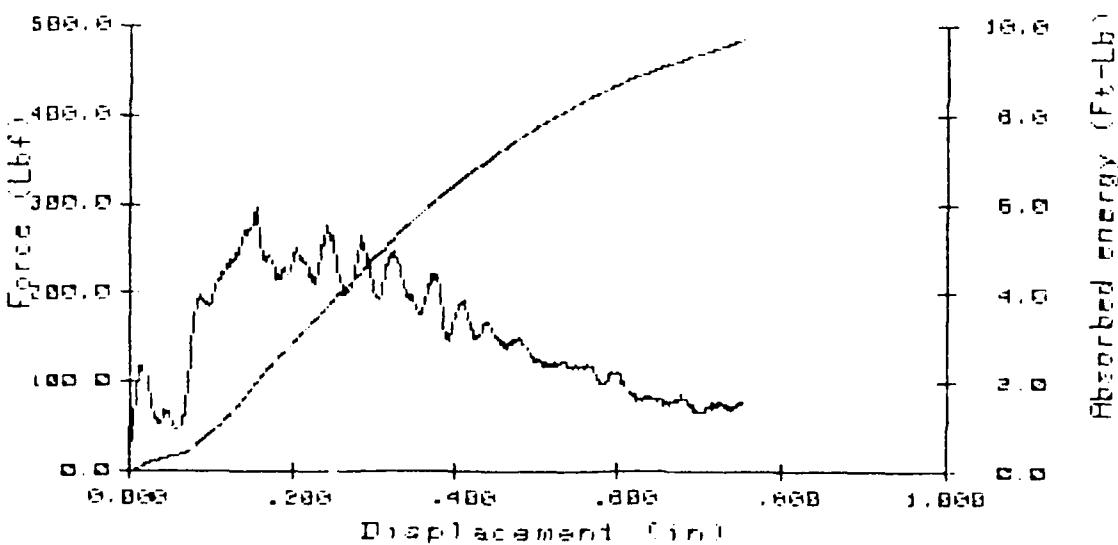
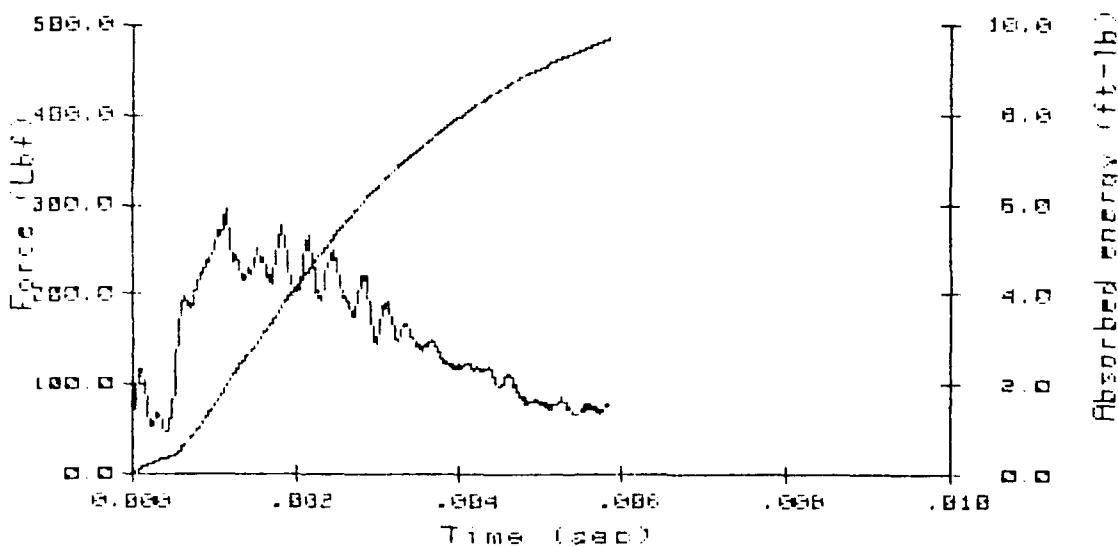
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 INSTRUMENTED IMPACT TEST
 =====

A110 GR/BMI //

Drop weight = 31.36Lb Data disk MAT00701
 Tup radius = .500in DRM scale .8Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 11.11ft/s
 E.E. = 60.12ft-Lb V_f (calc) = 10.37ft/s

Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)
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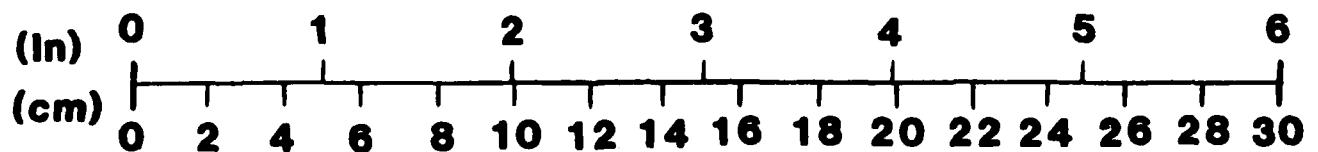
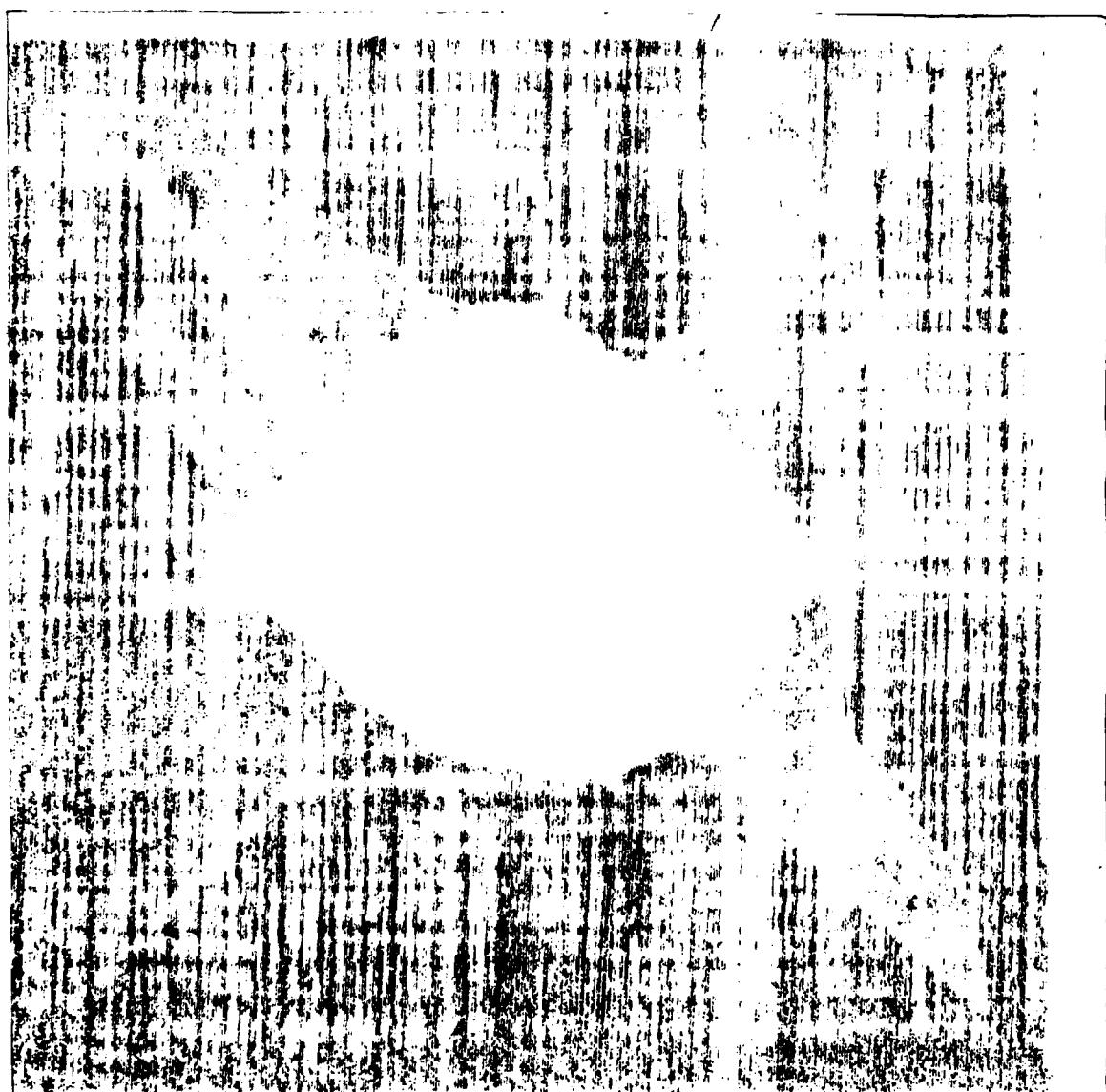
294.9	1.155E-3	1.98	.1553	Maximum force
77.3	5.845E-3	9.69	.7511	Maximum energy
77.3	5.845E-3	9.69	.7511	Maximum displacement
77.3	5.845E-3	9.69	.7511	Final values



NADC-85023-60

A130 GR/BMI

#1



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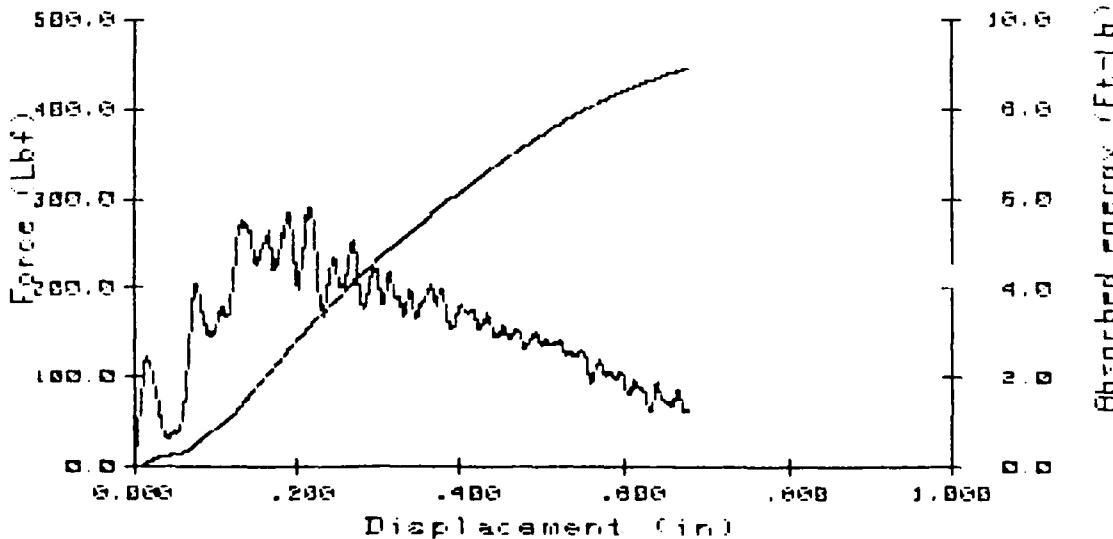
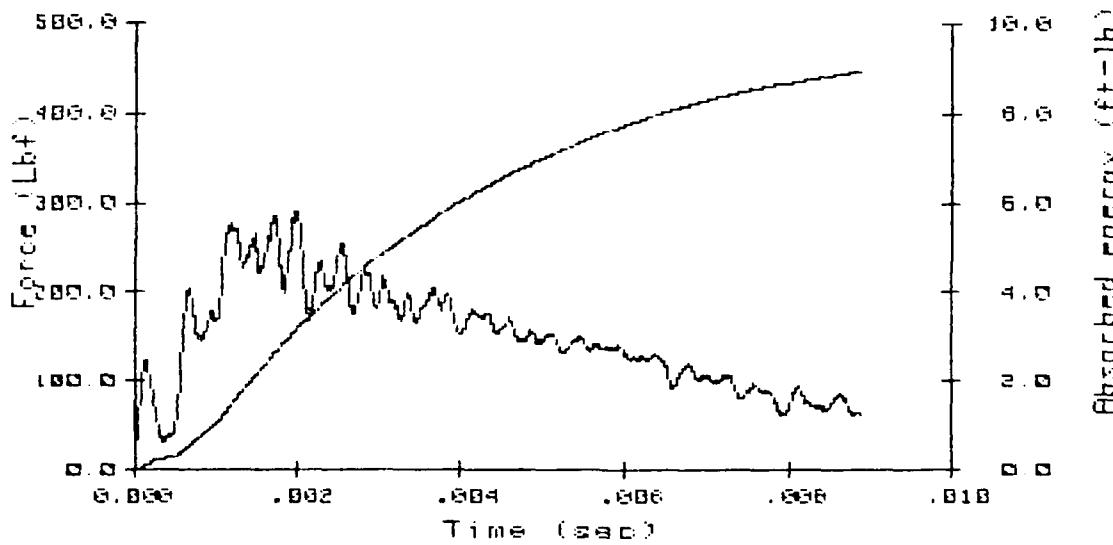
INSTRUMENTED IMPACT TEST

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A130 GR/BMI #2

Drop weight = 7.00LB Data disk MAT00703
 Tup radius = .500in DRM scale .4Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 9.66ft/s
 K.E. = 10.15ft-Lb $V_f(\text{calc})$ = 3.84ft/s

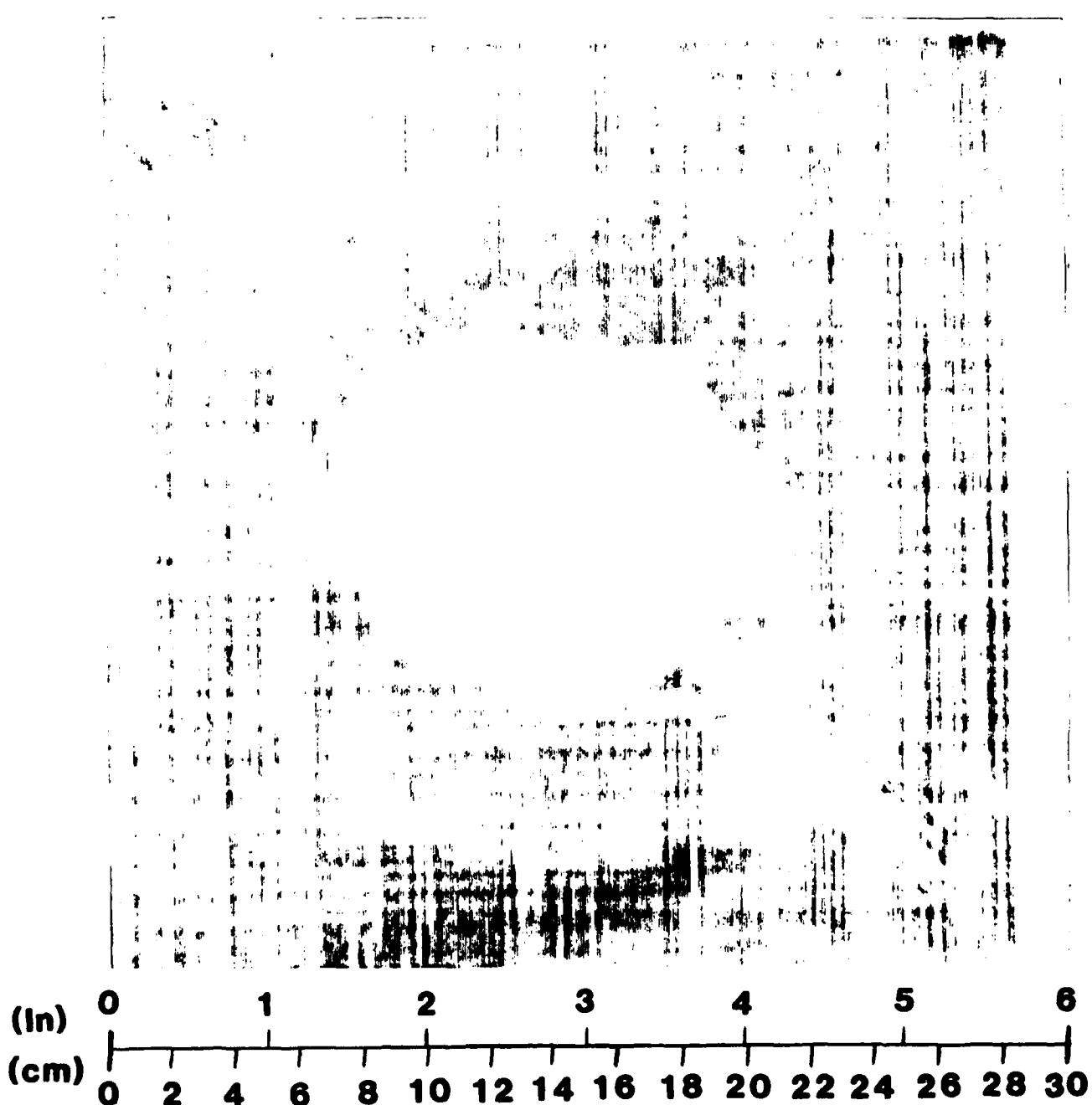
Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
291.4	1.983E-3	3.11	.2167	Maximum force
62.9	8.888E-3	8.94	.6762	Maximum energy
62.9	8.888E-3	8.94	.6762	Maximum displacement
62.9	8.888E-3	8.94	.6762	Final values



NADC-85023-60

A130 GR/BMI

#2



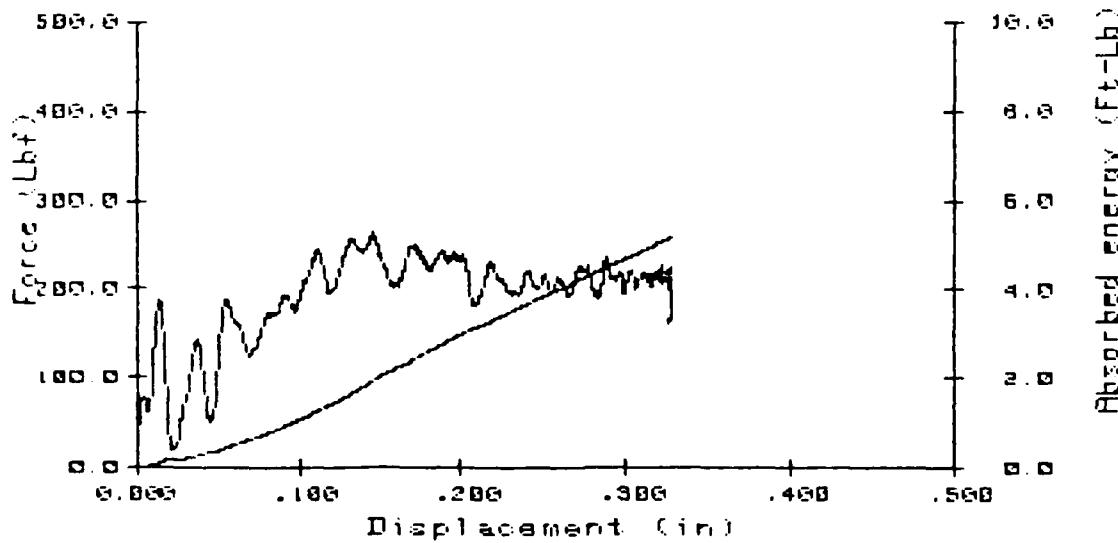
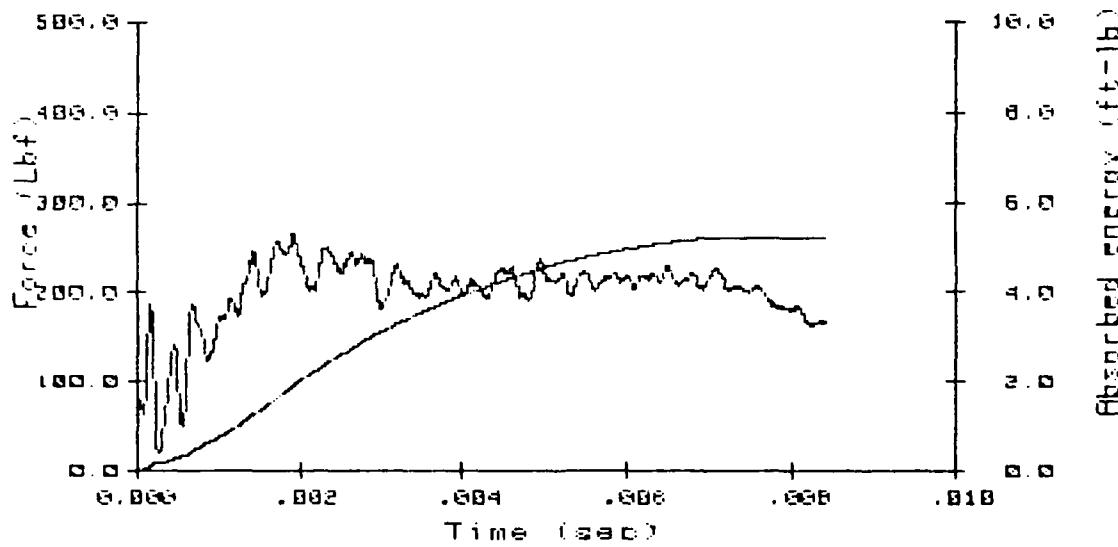
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 INSTRUMENTED IMPACT TEST
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A130 GR/BMI #3

Drop weight =	7.00Lb	Data disk =	MAT00705
Tup radius =	.500in	DRM scale	.4Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V ₀ =	6.80ft/s		
K.E. =	5.03ft-Lb	V _f (calc) =	-.64ft/s

Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)
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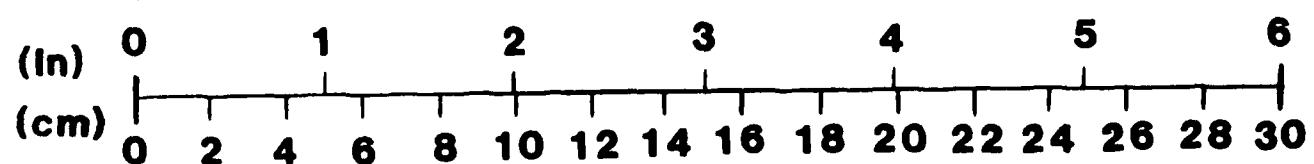
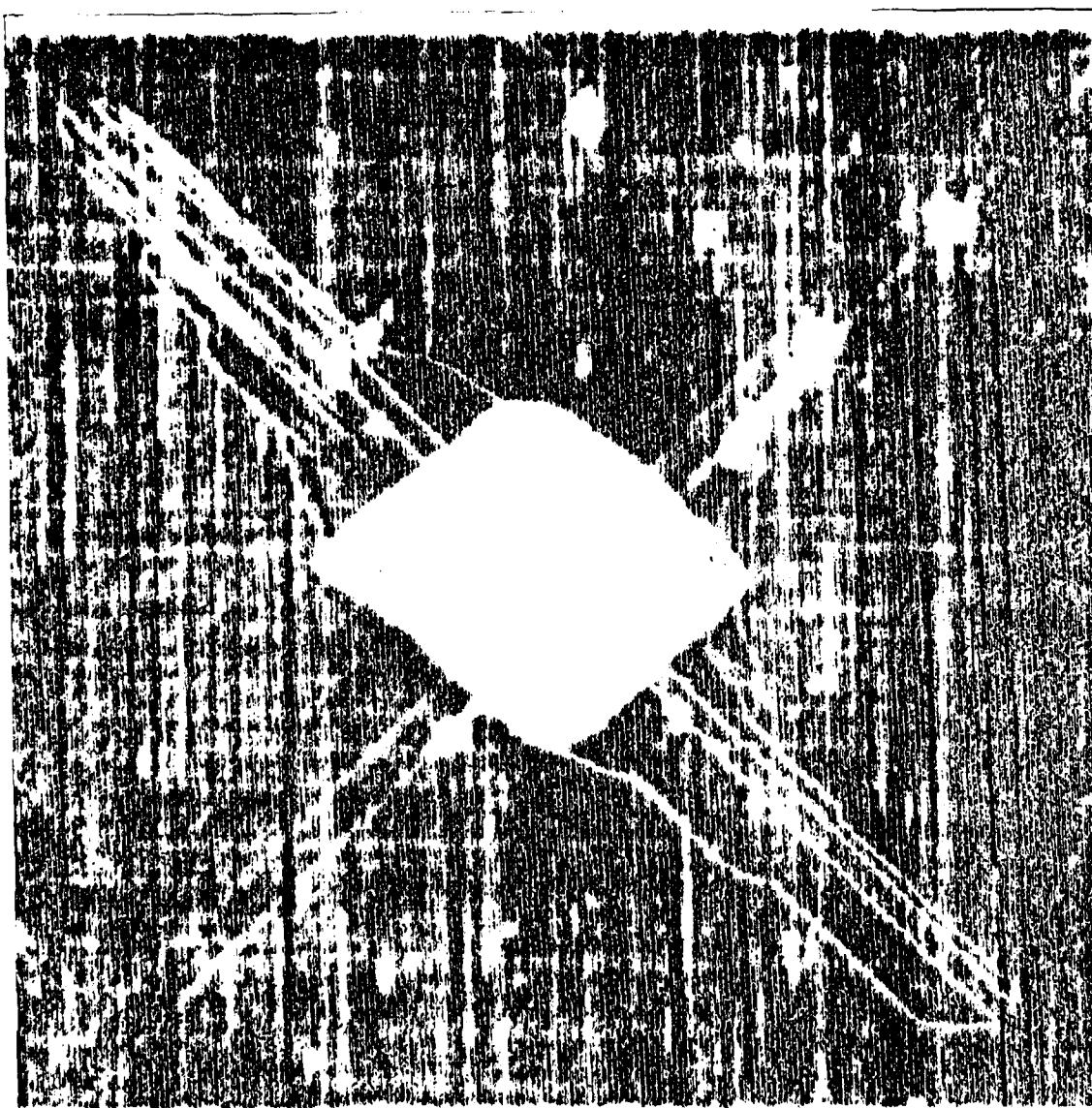
265.3	1.918E-3	1.91	.1447	Maximum force
205.0	7.608E-3	5.22	.3282	Maximum energy
205.0	7.608E-3	5.22	.3282	Maximum displacement
164.6	8.423E-3	5.17	.3250	Final values



NADC-85023-60

A130 GR/BMI

#3



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

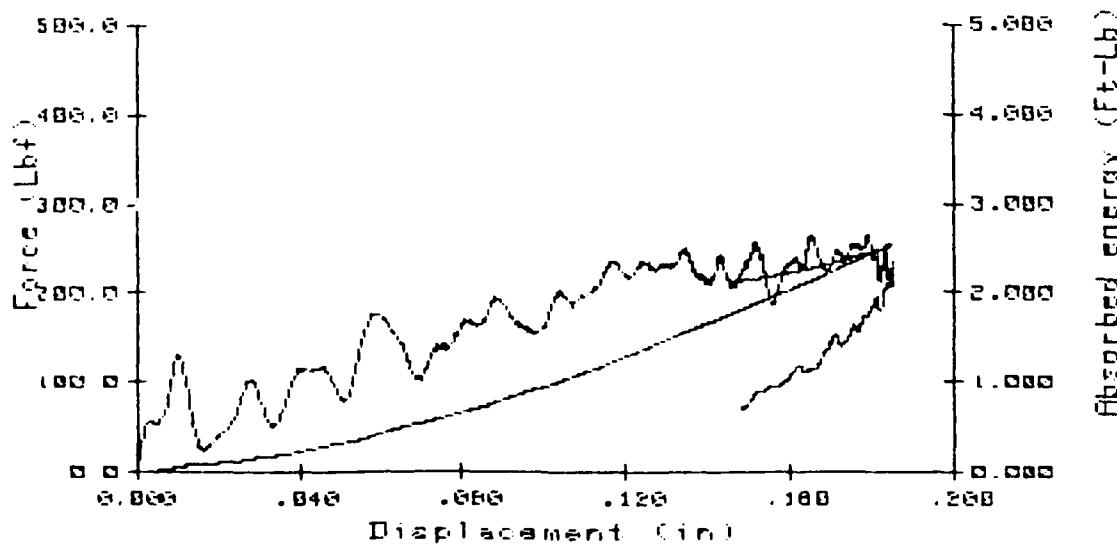
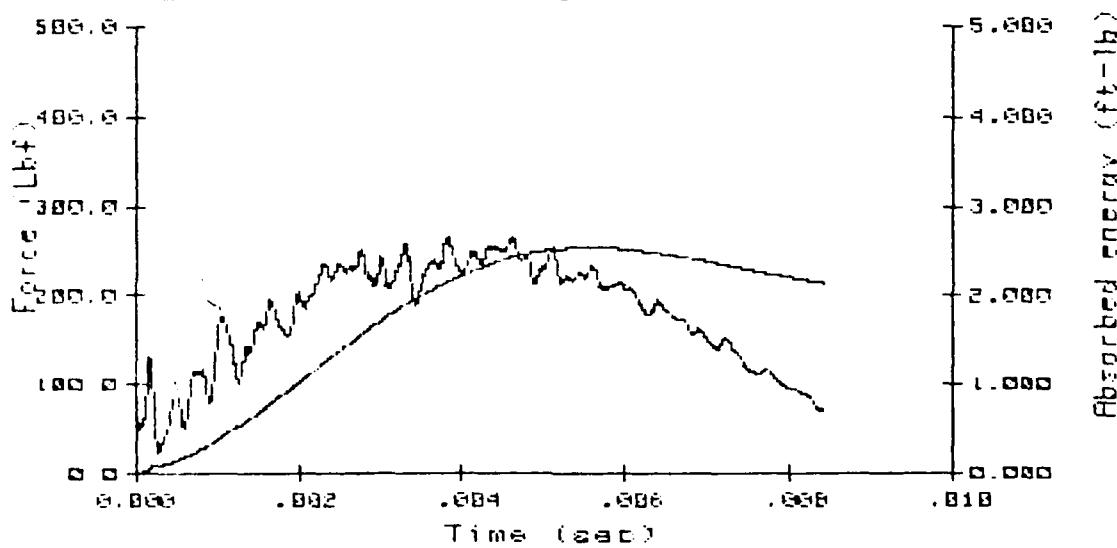
1/17/84

=====
 INSTRUMENTED IMPACT TEST
 =====

A130 GR/BMI #4

Drop weight =	7.00Lb	Data disk =	MAT00707
Tup radius =	.500in	DRM scale =	.2Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V_0 =	4.73ft/s		
K.E. =	2.43ft-Lb	V_f (calc) =	-1.87ft/s

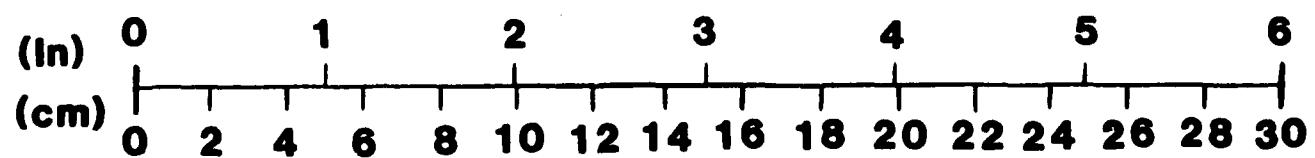
Load(Lb)	Time(s)	E_0 (Ft-Lb)	Disp(in)	
177.1	1.078E-3	.42	.0595	Initial damage
265.3	3.818E-3	2.14	.1653	Maximum force
232.0	5.593E-3	2.54	.1850	Maximum energy
232.0	5.593E-3	2.54	.1850	Maximum displacement
71.9	8.412E-3	2.14	.1478	Final values



NADC-85023-60

A130 GR/BMI

#4



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

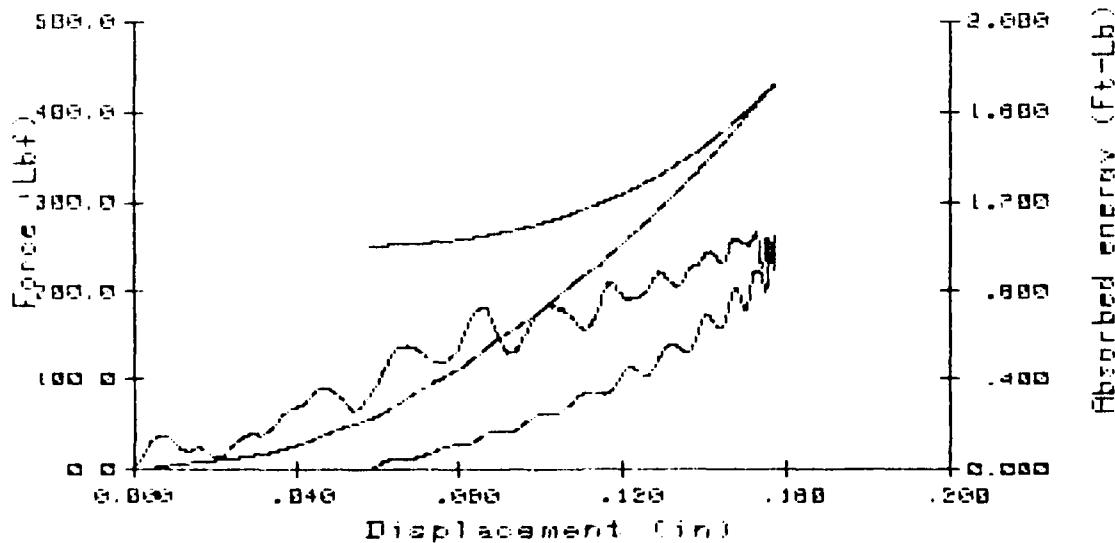
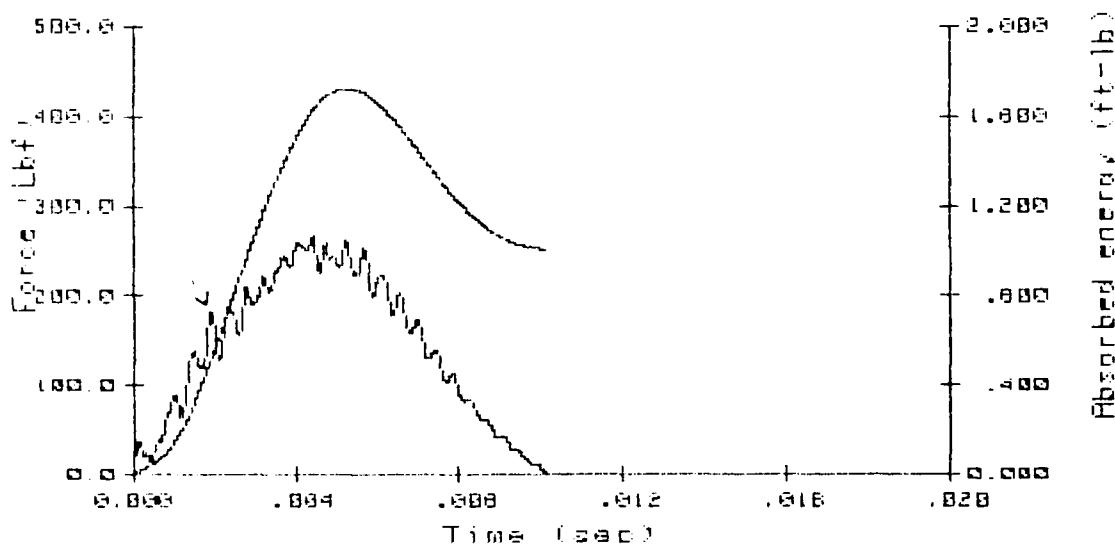
2/27/84

=====
INSTRUMENTED IMPACT TEST
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A130 GR/BMI #5

Drop weight = 7.00LB Data disk MAT00903
 Tup radius = .500in DRM scale .2Kn/Div
 Temperature = 74.0 F Flag grid= .040in
 V_0 = 3.88ft/s abs(Vf) = 3.00ft/s
 K.E. = 1.63ft-Lb Vf(calc) = -2.46ft/s

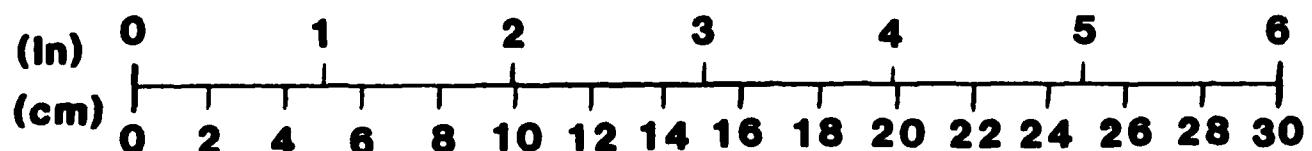
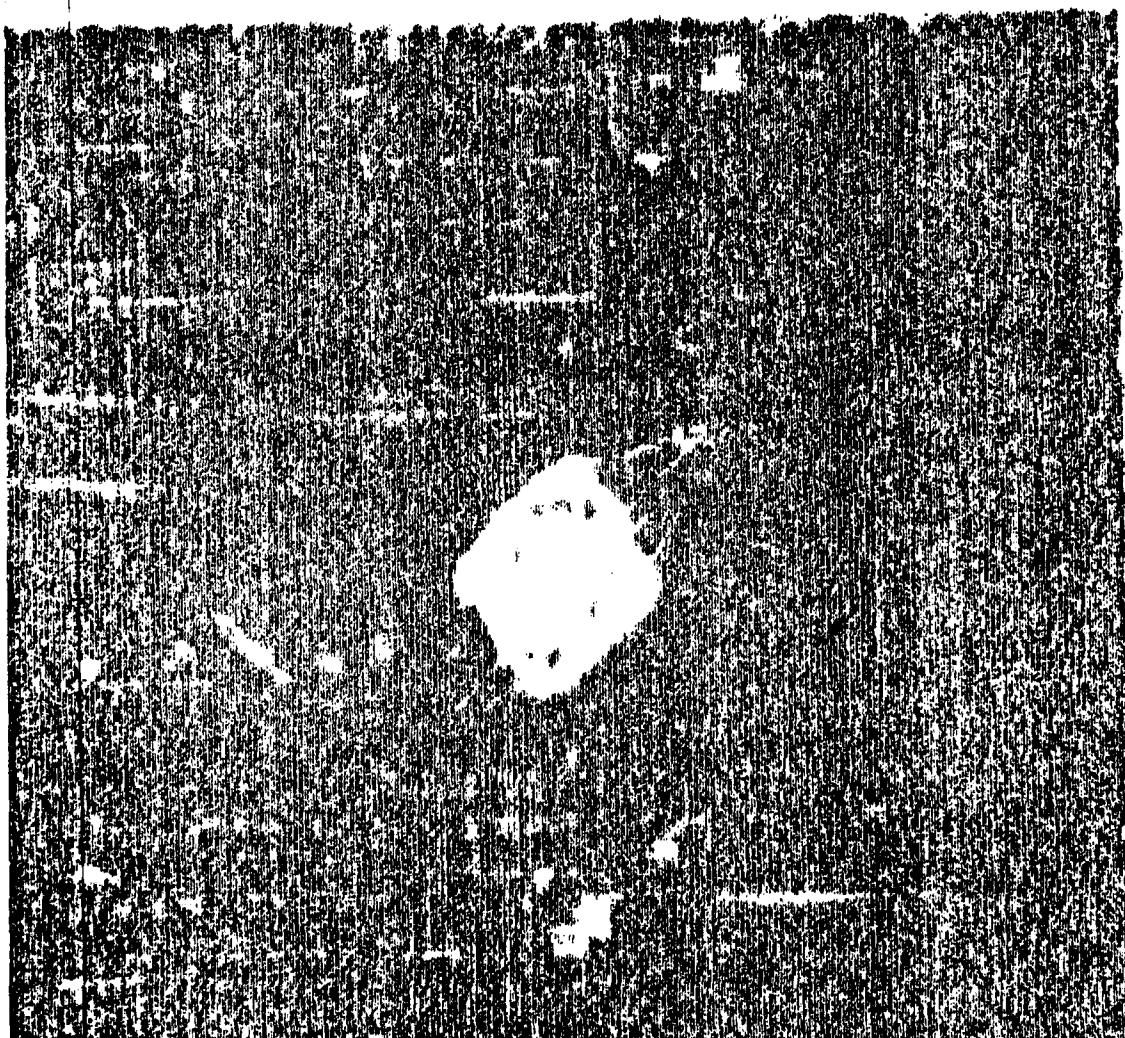
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
182.4	1.935E-3	.54	.0861	Initial damage
266.9	4.465E-3	1.63	.1526	Maximum force
249.6	5.295E-3	1.72	.1572	Maximum energy
249.6	5.295E-3	1.72	.1572	Maximum displacement
1.3	1.011E-2	1.01	.0582	Final values



NADC-85023-60

A130 GR/BMI

#5



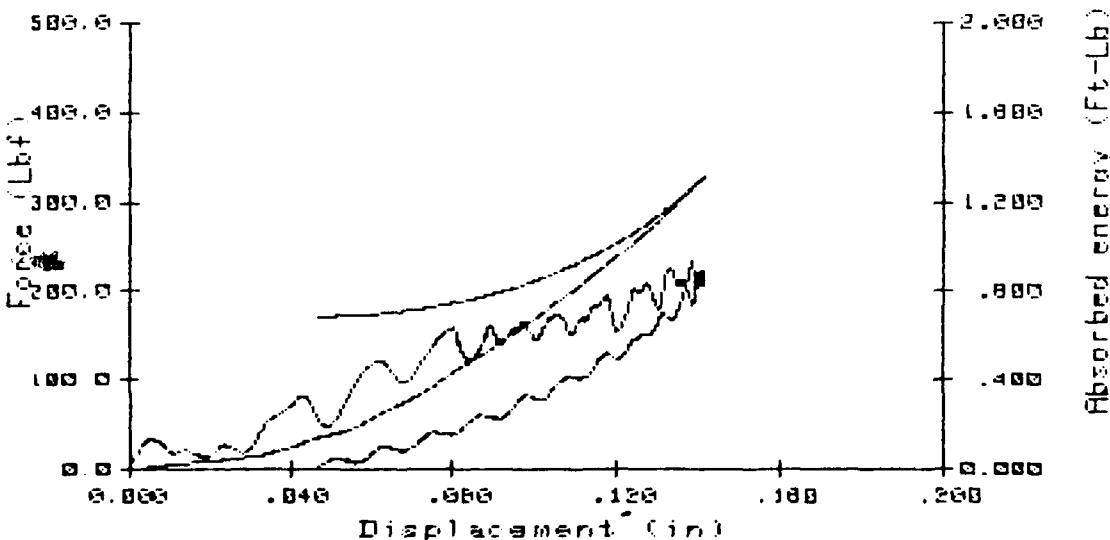
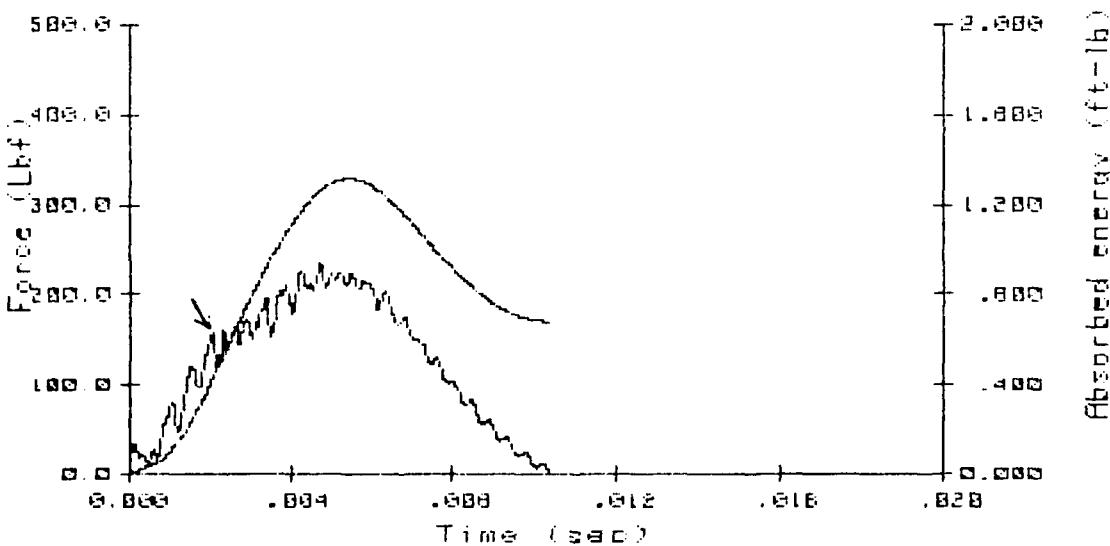
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 INSTRUMENTED IMPACT TEST
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A130 GR/BMI #6

Drop weight =	7.00Lb	Data disk	MAT01003
Tup radius =	.500in	DRM scale	.2Kn/Div
Temperature =	74.0 F	Flag grid=	.040in
V ₀	= 3.37ft/s	abs(V _f)	= 2.73ft/s
K.E.	= 1.23ft-Lb	V _f (calc)	= -2.30ft/s

Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)
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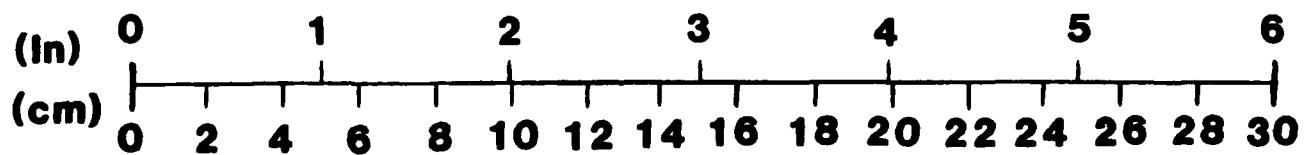
Load(Lb)	Time(s)	E0(Ft-Lb)	Disp(in)	
159.2	2.075E-3	.43	.0801	Initial damage
234.7	4.715E-3	1.26	.1383	Maximum force
218.5	5.445E-3	1.31	.1414	Maximum energy
218.5	5.445E-3	1.31	.1414	Maximum displacement
4.0	1.037E-2	.68	.0470	Final values



NADC-85023-60

A130 GR/BMI

#6



NADC-85023-60

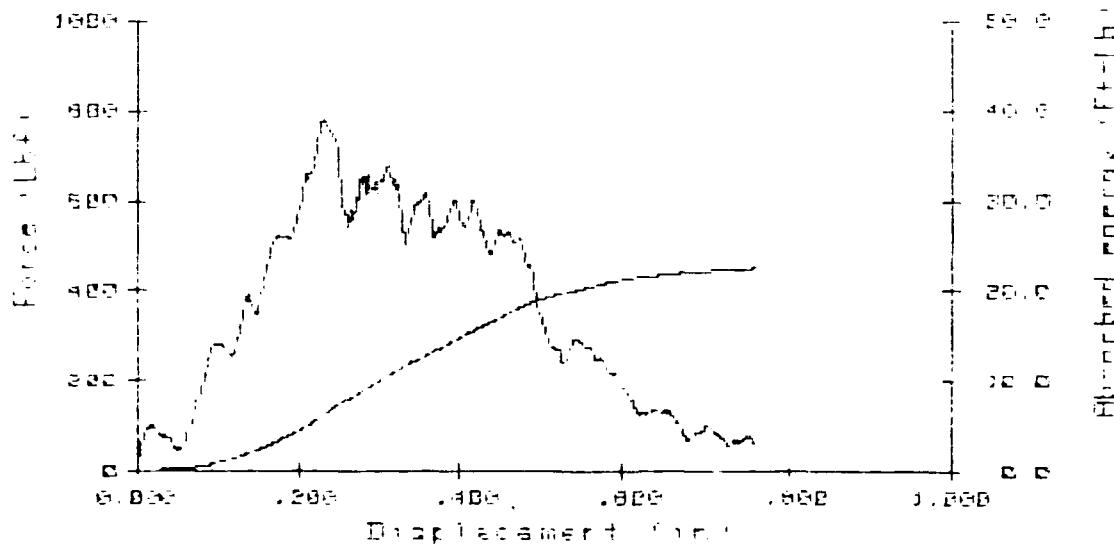
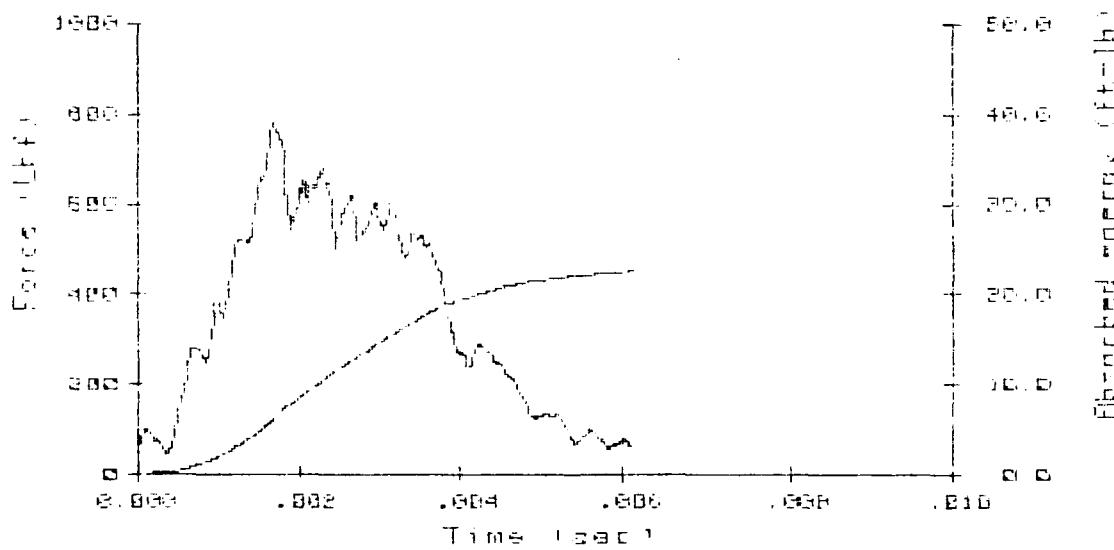
HX-1516

=====
 INSTRUMENTED IMPACT TEST
 =====

HX1516 #1

Drop weight =	31.36Lb	Data disk =	MAT01202
Tup radius =	.500in	DRM scale =	.8Kg/Div
Temperature =	74.0 F	Flag grid =	.040in
V_0 =	11.49ft/s	$\text{abs}(V_f) =$	9.01ft/s
K.E. =	64.34ft-Lb	$V_f(\text{calc}) =$	9.48ft/s

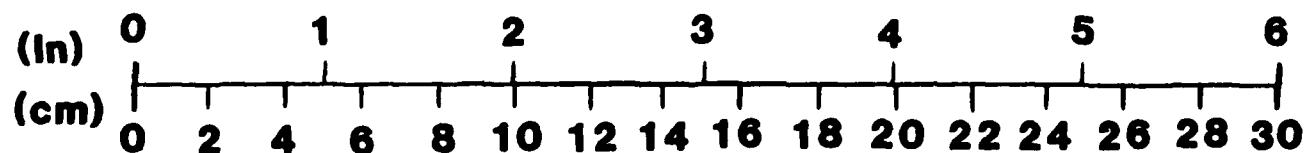
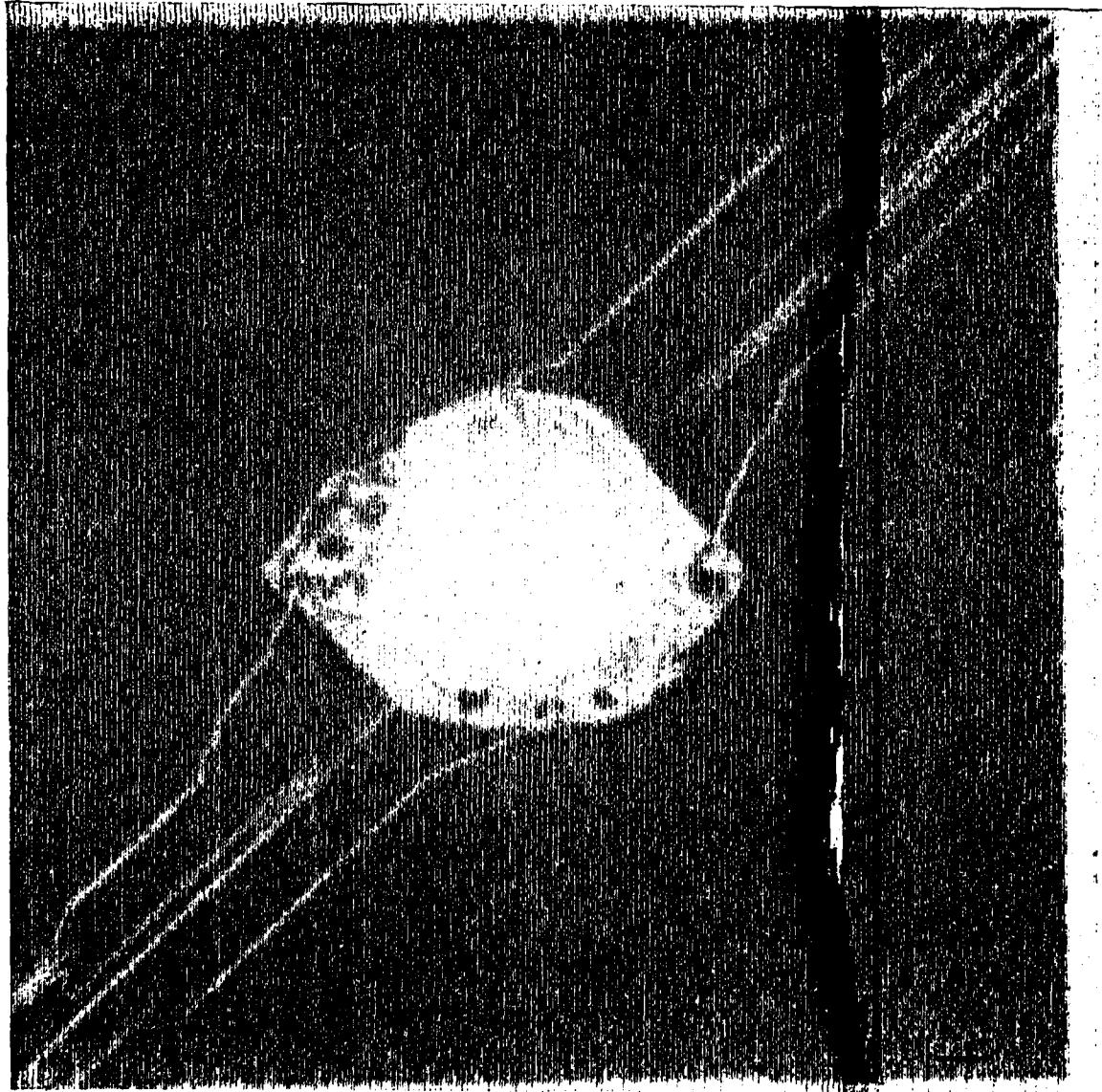
Load (Lb)	Time (s)	E0 (Ft-Lb)	Disp (in)	
780.5	1.695E-3	.6.26	.2327	Maximum force
66.5	6.125E-3	22.53	.7618	Maximum energy
66.5	6.125E-3	22.53	.7618	Maximum displacement
66.5	6.125E-3	22.53	.7618	Final values



NADC-85023-60

HX/1516

#1



NADC-85023-60

NADC/ETI-8200 DROP TEST FACILITY

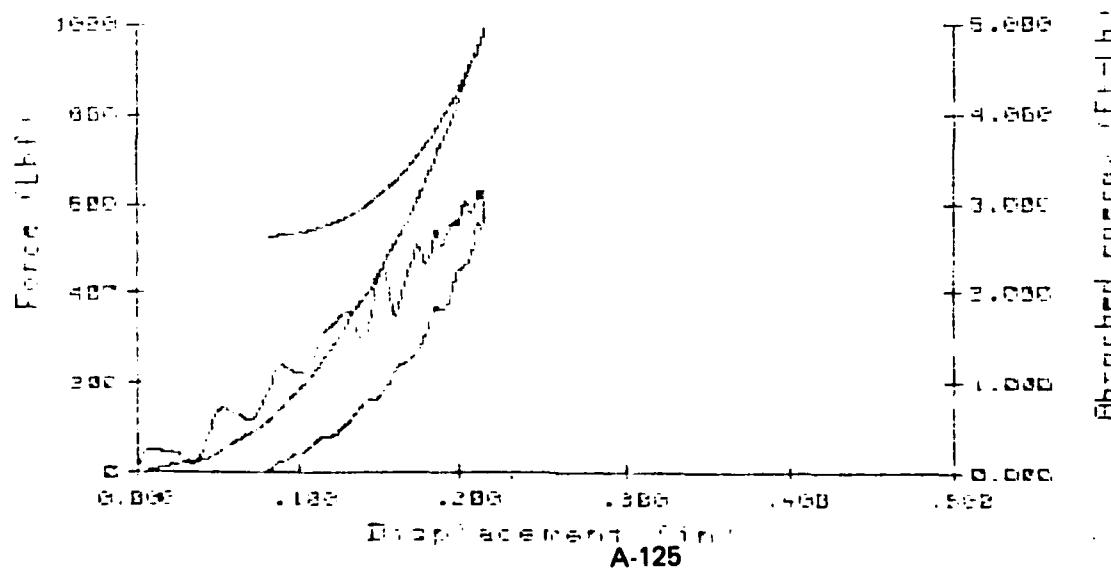
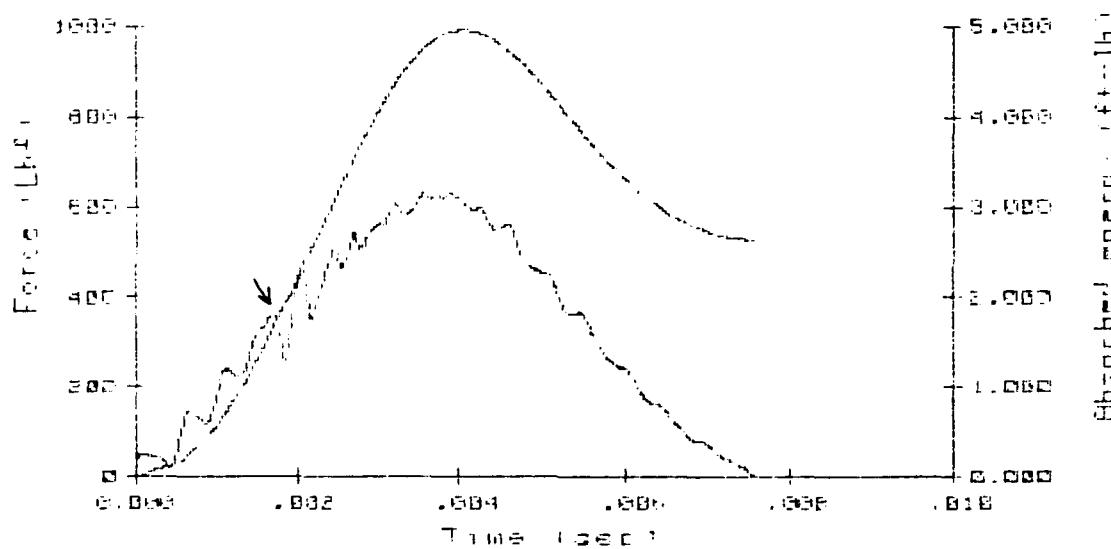
6/21/84

=====
 INSTRUMENTED IMPACT TEST
 =====

HX1516 #2

Drop weight =	7.00Lb	Data disk =	MAT01203
Tup radius =	.500in	DRM scale =	.4Kn/Div
Temperature =	74.0 F	Flag grid =	.040in
V_0 =	6.67ft/s	$\text{abs}(V_f) =$	5.85ft/s
E.E. =	4.83ft-Lb	$V_f(\text{calc}) =$	-4.55ft/s

Load (Lb)	Time(s)	EO(Ft-Lb)	Disp(in)	
358.8	1.705E-3	1.65	.1299	Initial damage
672.2	3.565E-3	4.76	.2111	Maximum force
609.7	4.045E-3	4.96	.2149	Maximum energy
609.7	4.045E-3	4.96	.2149	Maximum displacement
7.2	7.545E-3	2.63	.0920	Final values

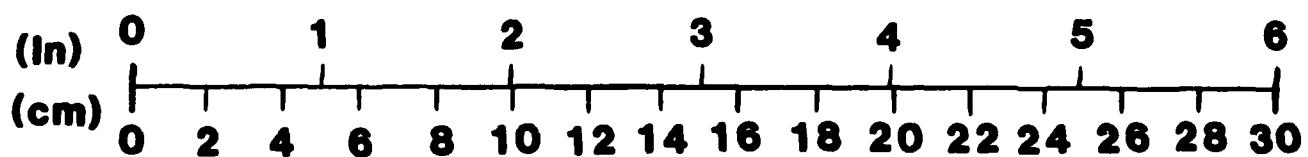
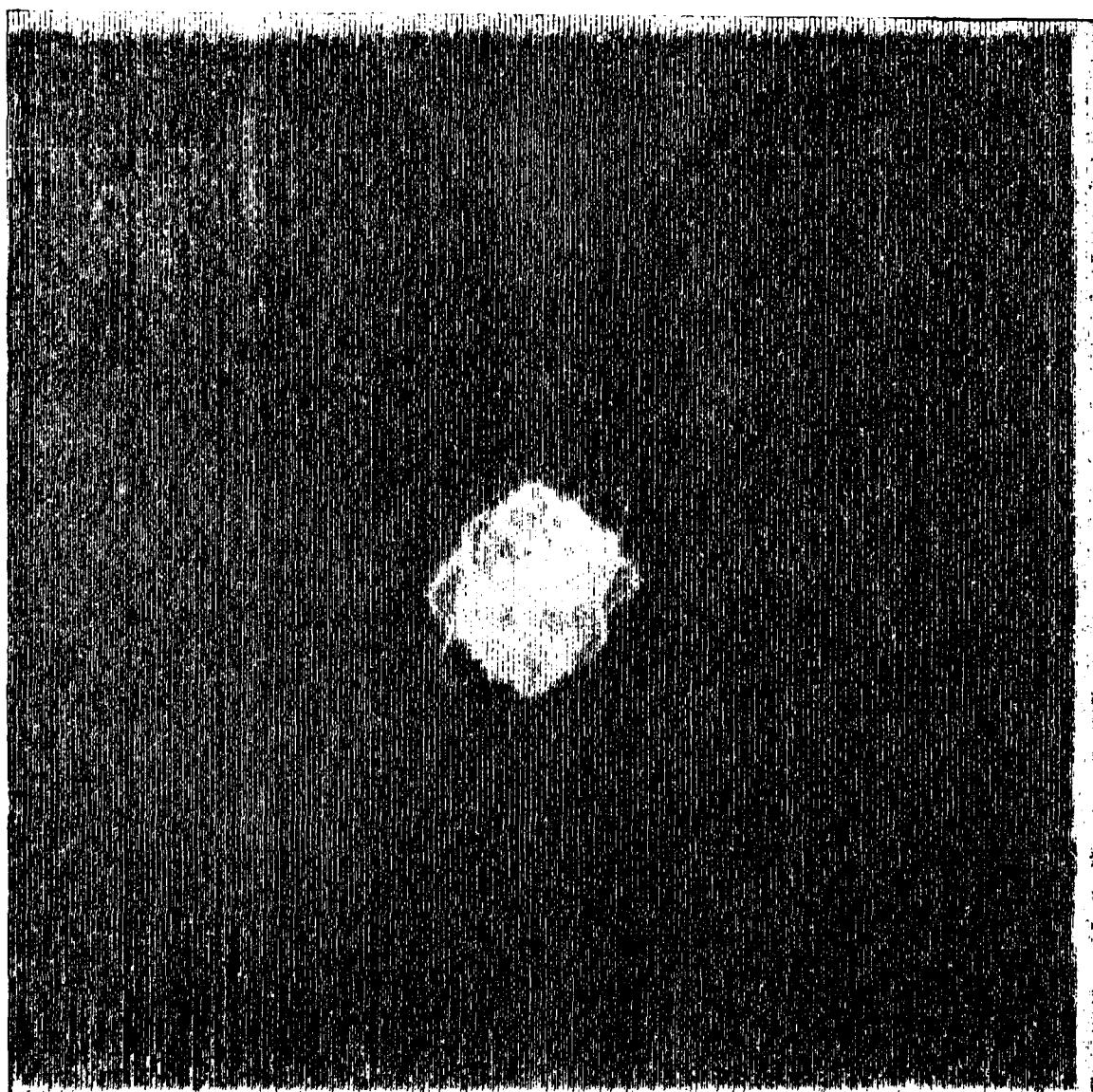


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HX/1516

#2



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